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CONTENTS.

PAGE.

ILLUSTRATED ARTICLES:
Electrical World Portraits—III., Prof. Henry A. Rowland.... 142
A Large Alternating Central Station in England.... 142
Automatic Pole Lightning Arrester.... 144
New Method of Inserting Storage Batteries in Cars.... 144
Alternating Current Ammeters.... 144
The Thomson-Houston Electric Railway at Des Moines.... 145
Thomson-Houston Electric Roads at Cambridge, Mass., and Wichita, Kan.... 145
New Sprague Electric Roads at Cleveland, Lafayette, Ind., and Salem, Mass.... 147
The Redding Battery Cover.... 148
The Hookham Electric Meter.... 148
A Novel Magnetic Watch Protector.... 148
A New Wimshurst Machine.... 148
The Electric Duel.... 149

CORRESPONDENCE:
A Few Telephone Questions.... 147
A Correction. By Edward H. Johnson.... 148
The Burning Out of Armatures. By H. F. Watts.... 148

EDITORIAL:
ELECTRICAL WORLD PORTRAITS.... 141
Paragraphs.... 141

MISCELLANEOUS:
The Adverse Gaulard-Gibbs Decision in England Sustained.... 141
Modern Views with Respect to Electric Currents. By Prof. H. A. Rowland.... 142
Ryde Pier Electric Railway.... 146
The Electric Road at St. Catherine's, Can.... 146
"Morse" Used on Long Cables.... 146
Multiplex Telephony on Long Lines.... 146
Absolute Resistance of Mercury.... 146
Incandescent Lamps for Army Signaling.... 147
An Analogy in Distribution.... 147
Edison-Westinghouse Litigation.... 149
New York Board of Electrical Control.... 149
Meeting of the American Institute of Electrical Engineers—Patten Discussion.... 150
New Carbon Brush for Railway Motors.... 151
Municipal Management of Manufactures. By S. A. Duncan.. 151
Mr. Kapp on Alternate Current Machinery.... 151

SPECIAL CORRESPONDENCE:
New York Notes, 152; New England Notes, 152; Philadelphia Notes, 152; Western Notes, 153; Southern Notes.... 153

DEPARTMENTS:
The Telegraph, 153; The Telephone, 153; The Electric Light, 153; Applications of Power, 153; Personals, 153; Business Notices.... 154
Our Illustrated Record of Electrical Patents.... 154

ELECTRICAL WORLD PORTRAITS.

With this issue is printed No. 3 of THE ELECTRICAL WORLD PORTRAITS, Prof. Henry A. Rowland, of Johns Hopkins University, Baltimore. It will be noticed that the portrait is published in the body of the paper, instead of upon a separate sheet. The reason for this change mainly is that many of our readers have lost their copies of the portraits, which hitherto were slipped loosely into the paper, and that in other instances, the sheet has sustained damage in the mail. In order, however, to meet the wishes of those who may desire to mount or frame these pictures, we have made arrangements for printing an edition on specially heavy chromo plate paper, and upon application and the receipt of 25 cents, these will be forwarded to any address in a stout mailing tube.

New Electric Roads. SOME idea of the rush and vigor shown in the new industry of electric railroading may be formed from the fact that we illustrate no fewer than six roads in all parts of the country. These roads are not mere experiments, but are all built for business and are nearly all on an extensive scale.

An Apt Analogy. THE usual way of explaining electrical actions by means of mechanical analogies is to compare the action of the electric current with the flow of water in pipes, and various analogies are employed to explain the method of distribution by means of transformers in which the high potential on the line wire is converted into low potential for domestic or local distribution. Another apt method of comparing the two latter is that given in our columns, in which the reducing action of the transformer is likened to the action of the reducing valve employed in the distribution of gas and water under high pressure. While, contrary to the belief of the author, the analogy is not entirely new, it is nevertheless a good one, and we have for that reason given it a place in our columns.

Methods of Illumination. THERE is a very keen and lively interest in many quarters in the subject of the efficiency of methods of artificial illumination. The great progress that has attended the introduction of the electric light has necessarily led to a close examination into the value of that light as compared with others, and has also provoked discussion as to the desirability of the various kinds of electric illuminants. At the present time, curiosity and inquiry are very active as to the possibility of obtaining electric light without heat, and thus new questions of efficiency and excellence are coming to the front. We are glad, therefore, to call attention to the fact that Prof. E. L. Nichols, of Cornell University, is to bring the subject, as a whole, before the American Institute of Electrical Engineers next week. The evening will undoubtedly be spent with great profit by all who participate.

Prof. Rowland. WE publish on the next page a portrait and biographical sketch of Prof. Henry A. Rowland, of Johns Hopkins University, being the third of THE ELECTRICAL WORLD portraits. It is a great pleasure to be able to pay this tribute to one who has done so much for electricity in this country, and has also done so much to enhance American reputation in the field of pure science. The reproach is often brought against America that the scientific work done here for its own sake is meagre, but if we could point to no other names than those of Henry and Rowland, we should have vindicated at least the department of electrical research. The abstract given of the address delivered at Baltimore on Feb. 22, by Prof. Rowland, on "Modern Views with Respect to Electric Currents," is a timely accompaniment to the outline presented of his previous investigations in the same domain.

Municipal Lighting Plants. OWING to the great pressure of business at the recent Chicago meeting of the National Electric Light Association, President Duncan abstained from reading a paper that he had prepared as an argument against the municipal ownership of electric light plants. Fortunately, however, the paper has now been given out for publication, as part of the proceedings, and it will be found in our present issue. It is a strong and convincing document, and its historical survey of State and city investments in commercial enterprises in Pennsylvania is full of interesting information directly pertinent to the topic. It is a tale of disaster and failure, and probably can be matched wherever like attempts have been made. Admitting that there is a drift of popular sentiment just now toward municipal control of electric lighting, we believe a change of mind will come; and it will certainly be hastened by such papers as this from Mr. Duncan.

Synchronism and Isochronism. THE discussion which took place on the paper read by Lieut. Patten before the American Institute of Electrical Engineers is well worthy of perusal, containing, as it does, a number of important points in the practical application of synchronous devices to multiplex telegraphy. One evidently practical consideration in the application of any such system is the minimum number of impulses which can be employed in the transmission of Morse signals successfully, and, on the other hand, the maximum number of impulses which can be transmitted over a line in a given time, maintaining their individuality. Both these points determine in the one case the speed of transmission for each individual operator, and in the second place the number of operators that can be simultaneously placed upon a single circuit. The discussion brings out very well some practical data regarding the most successful synchronous system now in use, the Delany, and it is to be hoped that Lieut. Patten will soon be in a position to demonstrate over an actual line wire the capability of the ingenious system devised by him.

Carbon Railway Brushes. THE difficulties which were experienced with the brushes on dynamos in the early days of electric lighting called forth the suggestion that carbon might be employed for that purpose instead of copper, in order to avoid frequent renewal. This suggestion has, however, not been carried out to any extent in the field of electric lighting, probably due to the fact that machines were very soon sufficiently improved or so easily accessible as to make such a brush unnecessary. But we note that the idea has already been revived, and indeed is in practical operation, in connection with electric railways. An article in another column gives the experience of a number of persons who have used the brush with good success. Naturally a railway motor placed under a car, even under the best conditions, is exposed to many influences which the dynamo, securely housed, never experiences, and anything which can conduce to continued operation and the reduction of running expenses, in electric railway work, must be looked upon as a decided advance.

Modern Electrical Theories. As time passes, and the heretofore unconnected links are supplied and put together in the chain of evidence to support our hypotheses on the nature of electricity, the truth is forced upon us that the theory which at the present time may be said to be an established one among men of science is fairly accurate, and certainly comprehensive enough to embrace all the phenomena which are known. In discussing the modern views regarding the electric current, Prof. H. A. Rowland shows that a few striking phenomena, taken together and reduced to one primal cause, point quite conclusively to the necessary existence of some medium by which electrical action, whatever its nature may be, is transmitted; this medium being placed in a state of potentiality which it did not possess before the electrical influences were applied to it. Prof. Rowland points out very forcibly that we have to consider not only actions which go on within the conductor, transmitting the so-called manifestation of force, electricity, but that that peculiar state is equally existent beyond the limits of the conductor in space; and indeed that electrical disturbances are transmitted into space far beyond what is generally supposed to be the case, due entirely to the transmitting medium, the ether. "The electric current is an unsolved mystery," says Prof. Rowland, "but we have made a very great advance in understanding it when we know that we must look outside at the disturbances in the medium before we can understand it."

The Adverse Gaulard-Gibbs Decision in England Sustained.

Special Cable Dispatch to The Electrical World.

LONDON, March 4, 1889.—Last July Mr. Justice Kekewich decided, on the petition by Ferranti, that the Gaulard-Gibbs patent on distribution by transformers was bad, because it did not properly describe the process of distributing electricity under that method. In other words, the patent was too broad. He ordered the patent to be canceled and gave costs on what is known as the higher scale. The case was appealed immediately. The Appeal Court has this day delivered a judgment sustaining the decision of the court below.

With regard to the above decision, we may quote the following from an editorial of July 28, as explanatory of the verdict and the situation: "With reference to the Gaulard-Gibbs patent, the decision, which we have already published, is to the effect that the specifications and claims are not sufficiently clear, aside from the other questions of priority." In order that our readers may know the exact meaning of this decision, we quote here the claims attached to the Gaulard-Gibbs patent, which has just been decided invalid, and in which the words which stand in the original specification, but which have since been deleted by permission of the controller of patents, are inclosed in brackets:

First, the privilege of exclusively working our process of distribution, characterized by the following points, as above explained. The employment of an alternating current of a high tension for the generation in [unlimited] a number of secondary generators of induced currents individually utilized either for the production of light or motive power. Second, a system of electrical distribution, such as is laid down in the foregoing statement. [Third, the special construction as described of secondary generators, designed to produce this result.]

While this patent is thus invalidated, it must be borne in mind that there is at least another English patent by the same inventors which, it is claimed, still controls this method of distribution."

ELECTRICAL WORLD PORTRAITS.—III.

PROF. HENRY A. ROWLAND.

"It is necessary that some should go before to clear the way for the world's advance. This is the work of the pure scientist; to him the problem of the universe is worth devoting his life, and he looks upon wealth as only adding to his means of research. He hopes not to solve the problem himself, but is contented if he may add some small portion to human knowledge; if he may but do his part in the march of human progress. He looks not for practical applications, but he knows full well that his most abstruse discoveries will finally be made useful to men at large, and so troubles himself no further about it." These are striking words, and are characteristic of the physicist who uttered them, Prof. Henry A. Rowland, of Johns Hopkins University, whose portrait appears in this issue as the third of THE ELECTRICAL WORLD series.

As to ancestry, it may be stated that the Rev. H. A. Rowland, father of the distinguished son of the same name, and himself a personage of no mean distinction, and of old Connecticut Congregational stock, was a graduate of Yale and Andover, and a pastor in the Presbyterian Church for nearly thirty years. It is evident that the genius of the boy soon found its object and career, and was helped on, for in 1870, when he was barely of age, Prof. Rowland graduated from the Rensselaer Polytechnic Institute at Troy as a civil engineer. The next year found him railroad surveying in Western New York; but his ability as a teacher was already recognized and his services were called into requisition at Wooster University. In 1872 he returned to Rensselaer as instructor in physics, and in 1874 he became assistant professor.

In the meantime he had completed his now widely-known experiments on magnetic permeability, but at first he was unable to get them published. The scientific journals in America rejected his work, but confident of its value, he sent his results to Clerk Maxwell, who at once had them published in the "Philosophical Magazine," and wrote kindly and encouraging letters to the young investigator. He was now becoming known, and when the authorities of the newly-founded Johns Hopkins University, at Baltimore, cast about them for some one to fill the chair of physics and become director of the physical laboratory, Rowland, with his already recognized ability and with the countenance which Maxwell's recognition of his talents gave, was chosen for the place. Professor Rowland accepted the chair, which he still holds with credit to himself and with great honor to a university that he has since then done so much toward making the great seat of American learning and the true home and sanctuary of science that we all know it to be. This was a year before the University actually opened, and the interval he spent in Europe, working in Berlin with Helmholtz. Here he investigated the effect of static electricity in motion, and proved that a moving charge has the effect of a current.

While the energies of Professor Rowland have been largely devoted to exhaustive researches into the nature and phenomena of electricity and magnetism, his work takes a broad sweep through pretty well the whole range of physics. His original work has been extensive, and many of the investigations made under his direction at Johns Hopkins are of world-wide celebrity, such, for example, as his determination, for the government, of the exact value of the ohm as the standard unit of resistance. To the public his name is probably even more familiar in connection with his large diffraction gratings, which are ruled by a method of his own directly on concave mirrors, the image of the solar spectrum being thus produced without the aid of lenses. In fact, the photographs of the spectrum obtained with the aid of these gratings far exceed anything else of the kind, and their exhibition before the National Academy of Sciences in 1883 was one of the leading scientific events of the year.

The well earned degree of Ph.D. was conferred upon Prof. Rowland by Johns Hopkins University in 1880. As a member of the Electrical Congress at Paris in 1881, and of the jury at the Electrical Exhibition at the same time and place, he received the order of a chevalier of the legion of honor. In 1881 he was elected a member of the National Academy of Sciences. In 1883 he presided over the Physics Section of the American Association for the Advancement of Science, at Minneapolis, and read a memorable address, entitled "A Plea for Pure Science." In 1884, being appointed by the government on the commission specially formed for the purpose, he presided over the deliberations of the National Conference of Electricians at Philadelphia, and delivered an address from which the quotation above is made. During the same year he received from the American Academy of Arts and Sciences, of which he is an associate, the Rumford medal for his researches in light and heat.

Some idea of the ground covered by his special studies may be gathered from the following incomplete list of his papers published at various times: "On Magnetic Permeability" (1873); "On the Magnetic Permeability and Maximum Magnetization of Nickel and Cobalt" (1874); "Studies on Magnetic Distribution" (1875); "On a Magnetic Effect of Electrical Convection" (1876); "Research on the Absolute Unit of Electrical Resistance" (1878); "On the Mechanical Equivalent of Heat" (1880); "On Concave Gratings for Optical Purposes" (1883); "On the Relative Wave Lengths at the Lines of the Solar Spectrum" (1886); the article on "Screws" in the "Encyclopædia Britannica;" and "Photographs of the Normal Solar Spectrum" (seven plates, 1886, and a new series of nine plates in 1888). To this list may be added the address delivered at Baltimore on Friday, Feb. 22, before the University and a number of physicists, on "Modern Views in Respect to the Nature of Electric Currents." We give an abstract of the address below.

In addition to developing the resources of the physical and electrical laboratories at Johns Hopkins, where an electrical testing bureau of great promise has also been lately established, Prof. Rowland in some manner continues to devote time to many other matters of importance. He is corresponding member for the British Association for the Advancement of Science, and of the Cambridge Philosophical Society, is one of the twelve foreign members of the Physical Society of London, and is a permanent member of the International Commission for establishing electrical units. It is possibly by way of recreation that he has entered the ranks of "amateur" photographers, and has produced such exquisite specimens as those which were published in "Harper's Magazine" of January last as illustrative of American skill in the use of the camera.

PROF. HENRY A. ROWLAND.

Modern Views With Respect to Electric Currents.*

BY PROF. HENRY A. ROWLAND, JOHNS HOPKINS UNIVERSITY.

As only a short time since I stood in a library of physical books and glanced around me at the works of the great masters on that subject, my mind wandered back to the time when the apparatus for a complete course of lectures on the subject of electricity consisted of a piece of amber and a few light bodies to be attracted by it. From that time until now, when we stand in a magnificent laboratory, with elaborate and costly apparatus in great part devoted to its study, how greatly has the world changed and how our science of electricity has expanded both in theory and practice, until in the one case it threatens to include within itself nearly the whole of physics, and in the other to make this the age of electricity. [Prof. Rowland then illustrated some recent discoveries by neat experiments.]

Coil a number of wires around a piece of glass, or indeed almost any transparent substance, and pass a strong current through the wire. With our naked eyes we see no effect whatever, as the glass is apparently unaltered by the presence of the current. But examining in the proper way by means of polarized light, we see that the structure of the glass has been altered throughout in a manner which can only be explained by the rotation of something within the glass many million times every second.

Thus by these tests we find that the region around an electric current has very peculiar properties which it did not have before, and which, although stronger in the neighborhood of the current, still extend to indefinite distances in all directions, becoming weaker as the distance increases. How great, then, is the difference between a current of water and a current of electricity! The action of the former is confined to the interior of the tube, while that of the latter extends to great distances on all sides, the whole of space being agitated by the formation of an electric current in any one part. [Professor Rowland showed two large coils about six feet square and six feet apart, through one of which a current from the secondary of an induction coil was made to pass, and on breaking the circuit of the second coil bright sparks were seen.]

The question is forced upon us as to how this action takes place. How is it possible to transmit so much power to such a distance across apparently unoccupied space. According to modern views there must be some medium engaged in this transmission. We know that it is not the air, because the same effect takes place in a vacuum, and, therefore, we must fall back on that same mediun which transmits light and which we have named the ether. That medium, which is supposed to extend unaltered throughout the whole space, whose existence is very certain, but whose properties we have yet vagely conceived. [Returning again to the two coils mentioned above, and attaching Leyden jars to each. Prof. Rowland continued]: This combination of a coil of wire and a Leyden jar has been shown by Sir Wm. Thomson to be a vibrating system for electricity, and its time of vibration is about $\frac{1}{100000000}$ of a second. This second system is the same as the first, and therefore its time of vibration is the same. You see how well the experiment works now, because the two are in unison. But let me take away this second leyden jar, thus destroying the unison, and you see that the spark instantly ceases. In the case of a charged Leyden jar whose inner and outer coatings have been suddenly joined by a wire, the electricity flows back and forth along the wire until all the energy originally stored up in the jar has expended itself in heating the wire or the air where the spark takes place, and in generating waves of disturbance, which moves outward into space with the velocity of light. These ethereal waves we have demonstrated by letting them fall on this coil of wire, and causing the electrical disturbance to manifest itself by electric sparks.

A ready means of experimenting on the waves, obtaining their wave lengths and showing their interferences, has hitherto been wanting. This deficiency has been recently overcome by Prof. Hertz, of Carlsruhe, who has made a study of the action of the coil, and has shown us how to use it for experimenting on the ethereal waves, whose existence had before been made certain by our mathematics. Prof. Hertz established his apparatus in front of a reflecting wall and observed the nodes and loops by the sparks produced in a ring of wire somewhat resembling the coil I have been using on the present occasion. The testing coil is moved to different portions of the room, and the nodes are indicated by the disappearance of sparks and the loops by the greater brightness of them.

Our mathematics has demonstrated and experiments like those of Prof. Hertz have confirmed the demonstration that the wave disturbance in the ether is an actual fact. The electric current is an unsolved mystery, but we have made a very great advance in understanding it when we know that we must look outside of the wire at the disturbances in the medium before we can understand it,—a view which Faraday dimly held fifty years ago, which was given in detail in the great work of Maxwell, published sixteen years since, and has been the guide to most of the work in electricity for a long time,—a view which has wrought the greatest changes in the ideas which we have conceived with respect to all electrical phenomena.

The electrical waves at the surface of a conductor are in some respects very similar to the waves on the surface of water. The greater motion in the latter case is at the surface, while it diminishes as we pass downward, and soon becomes inappreciable. Furthermore, the depth to which the disturbance penetrates into the water increases with the increase of the length of the wave, being confined to very near the surface for very short waves. So the disturbance on the copper penetrates deeper as the waves and the time of oscillation are longer, and the disturbance is more nearly confined to the surface as the waves become shorter.

There are many practical applications of these theoretical results for electric currents, the most obvious one is the case of conductors for alternating currents used in producing the electric light. We find that when these are larger than about half an inch in diameter, they should be replaced by a number of conductors less than half an inch in diameter, or by strips about one-quarter of an inch thick and of a convenient width. But this is a matter to be attended to by the electric light companies. Prof Oliver J. Lodge has recently drawn attention, in the British Association, to another application of these re-

* Abstract of an address delivered during the celebration of the 13th anniversary of Johns Hopkins University, Feb. 22, 1889.

sults, namely, that of lightning rods. If I were called on to estimate as nearly as possible what took place in a flash of lightning, I would say that I did not believe that the discharge was always oscillatory, but more often consisted of one or more streams of electricity at intervals of possibly $\frac{1}{10}$ of a second, each one continuing for not less than $\frac{1}{10000}$ of a second. An oscillatory current with 100,000 reversals per second would penetrate about $\frac{1}{10}$ of an inch into copper, and $\frac{1}{100}$ of an inch into iron. The depth for copper would constitute a considerable proportion of a wire $\frac{1}{4}$ inch in diameter, and as there are other considerations to be taken into account, I believe it is scarcely worth while making tubes or flat strips for such small sizes.

It is almost impossible to draw proper conclusions from experiments on this subject in the laboratory, such as those of Prof. Oliver J. Lodge. The time of oscillation of the current in most pieces of laboratory apparatus is so very small, being often the $\frac{1}{10000000}$ of a second, that entirely wrong inferences may be drawn from them. In the light of our present knowledge the frequent failure of the old system of rods is no mystery, for I doubt if there are one hundred buildings in the country properly protected from lightning. With our modern advances perfect protection might be guaranteed in all cases if expense were no object. [Professor Rowland then stated Faraday's and Maxwell's views concerning "lines of force," and illustrated the supposed "tension along the lines of force" and their repellant action sidewise by a very ingenious model.]

We have thus done away with action at a distance, and have accounted for magnetic attraction by a change in the intervening medium, as Faraday partly did almost fifty years ago. For this change in the surrounding medium is as much a part of the electric current as anything that goes on within the wire.

When we use the electric light to illuminate our streets it is the luminiferous ether which conveys the energy along the wire as well as transmits it to our eye after it has assumed the form of light. When the wire falls to the ground, as it is sure to do sometimes, and it is touched by some unfortunate man or horse, it is the luminiferous ether which sounds his death knell. We step upon an electric street car and feel it driven forward with the power of many horses, and again it is the luminiferous ether whose immense force we have brought under our control and made to serve our purpose, no longer a feeble, uncertain sort of medium, but a mighty power extending throughout all space and binding the whole universe together so that it becomes a living unit, in which no one portion can be changed without ultimately involving every other portion.

A Large Alternating Current Station in England.

We illustrate on this page the very interesting central station on the Lowrie-Hall alternating system, recently

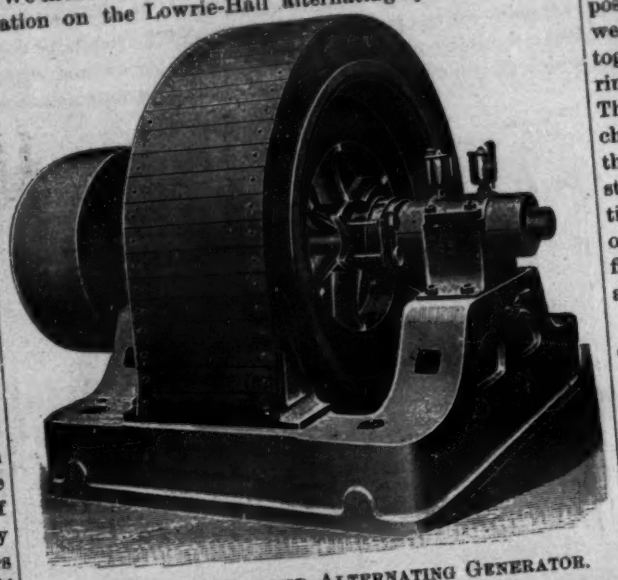


FIG 1.—LOWRIE-PARKER ALTERNATING GENERATOR.

put up by the House-to-House Electric Light Supply Company, at West Brompton, London. The plant at present contains three complete sets of apparatus, each set being capable of supplying 4,000 50-watt incandescent lamps, and the station when filled out to its capacity will be equal to 48,000 lamps. The engines, of horizontal type, were made by Fowler, of Leeds; the boilers were built by the Babcock & Wilcox Company, and the dynamos, specially designed by Messrs. Lowrie and Parker, were constructed by Elwell, Parker & Co. We are indebted to the London *Electrician* for our illustrations-Fig. 1 of which shows the dynamo, while Fig. 2 gives a view of a portion of the plant in operation.

The alternate-current dynamos are of a novel type. Running at 380 revolutions per minute the machine has an output of 100,000 watts. The mean speed at which the armature conductor is passed by the field-magnets is about 6,000 feet per minute, and the number of alternations 5,000 complete phases per minute; the E. M. F. is 2,000 volts. The armature, which is stationary, is built up on an iron core of large section composed of charcoal iron sheets thoroughly insulated from each other, arranged longitudinally and in the same plane with the magnetic fields; the conductor at full load carries 2,000 ampères per square inch of section. The armature coils are formed of narrow tape, each wound in a plane (or slightly curved to suit the radius) upon a piece of insulating material of the same thickness as the width of the tape, and rounded at the ends. The coils are thus of a flat link shape, the edges of the tape windings being exposed upon the flat surfaces of the coils, and therefore well able to resist deflection. These coils are placed close together upon the cylindrical inner surface of the armature ring, so that the axis of each coil is radial to the ring. They are secured by rebated strips of wood, screwed to the cheeks, and extended over the ends of the coils, outside the line of travel of the magnets. By this mode of construction the whole of the conductor (except a small portion at the ends of the coils parallel with the line of travel of the field) is placed under exactly the same inductive influence, and at the same distance from the moving poles, and consequently in the best position for efficiency.

Another great advantage is that no special means are required to keep the conductors from sagging or lifting from their normal position, and thus the clearance space is reduced to a minimum. Furthermore, as the armature coils are simply secured to the face of the armature, they are easily removed or replaced as required. The armature ring is parted upon the horizontal line, so that the upper half is removable for inspection or repairs. The frame for supporting the laminated iron armature core is cast separate, and securely bolted to planed facings.

The revolving field consists of a solid soft wrought-iron ring, with pole-pieces securely attached thereto, and is arranged so that the centrifugal force of the whole of the moving parts is taken by the ring. The energy absorbed by the field does not exceed 5 per cent. of the maximum output. The base-plate is of box-pattern, and strongly ribbed and under flanged where it bears on the slide rails. The plummer blocks for the bearings are cast separate from the base-plate, and secured by bolts and lugs and wrought-iron wedge keys.

The bearings are two in number, 20 inches long; they are in halves jointed on the horizontal centre and fitted with loose brasses, top and bottom. These brasses are of hard phosphor bronze. The bottom brass is so arranged that it can be removed without lifting the shaft, and yet well secured sideways; each bearing is fitted with two combined siphon and sight-feed lubricators. Each end of the bearing is provided with oil catchers, consisting of a chamber all round the shaft, by which the oil passing from the bearings is caught when thrown from the oil throwers provided on the shaft, and conducted by a passage formed in the plummer block under the brass to a waste oil tank or receiver formed in the plummer block or the base plate; each tank is provided with a drain cock fixed in suitable position for drawing off the waste oil.

The shaft is of the best mild steel, 6 inches in diameter,

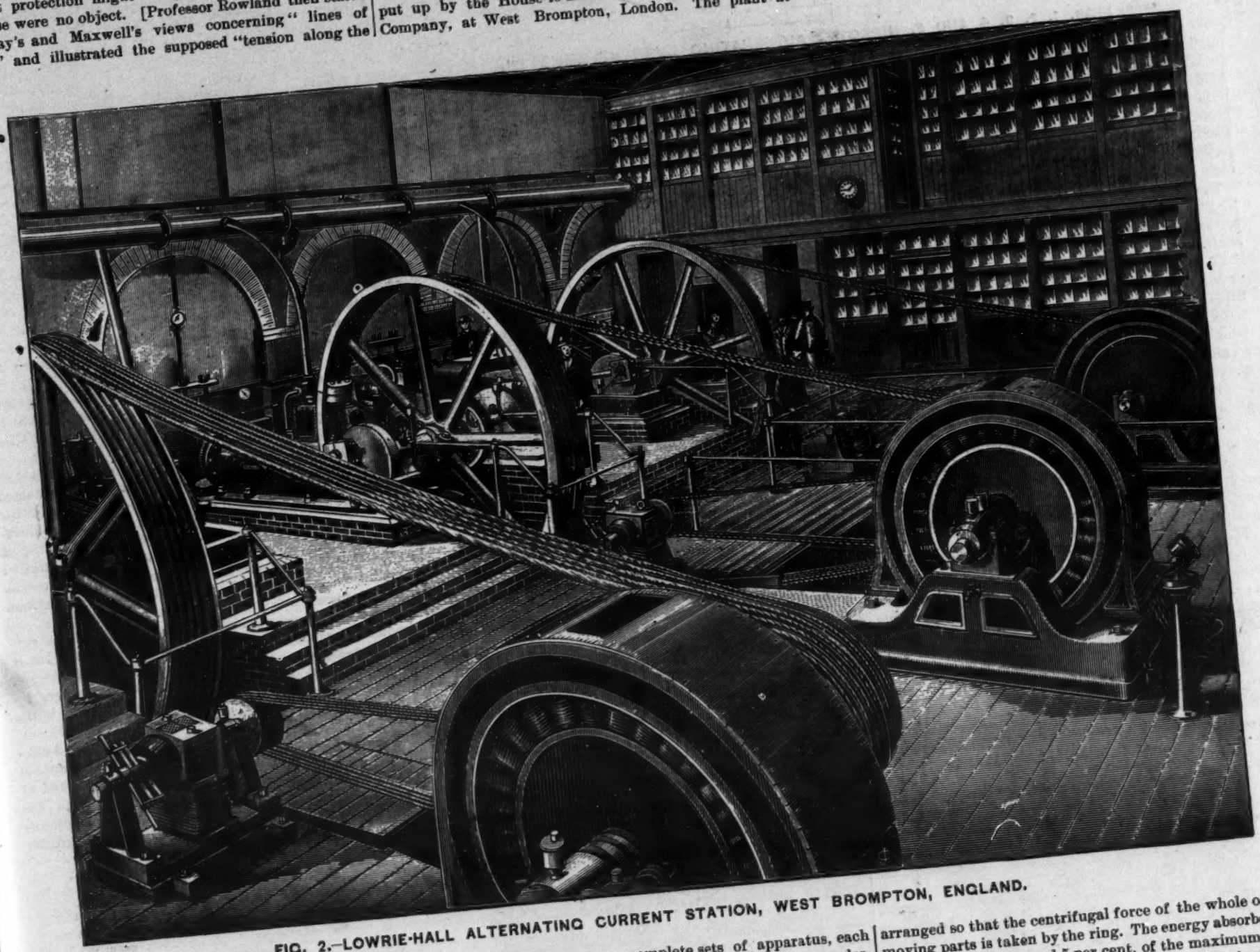


FIG. 2.—LOWRIE-HALL ALTERNATING CURRENT STATION, WEST BROMPTON, ENGLAND.

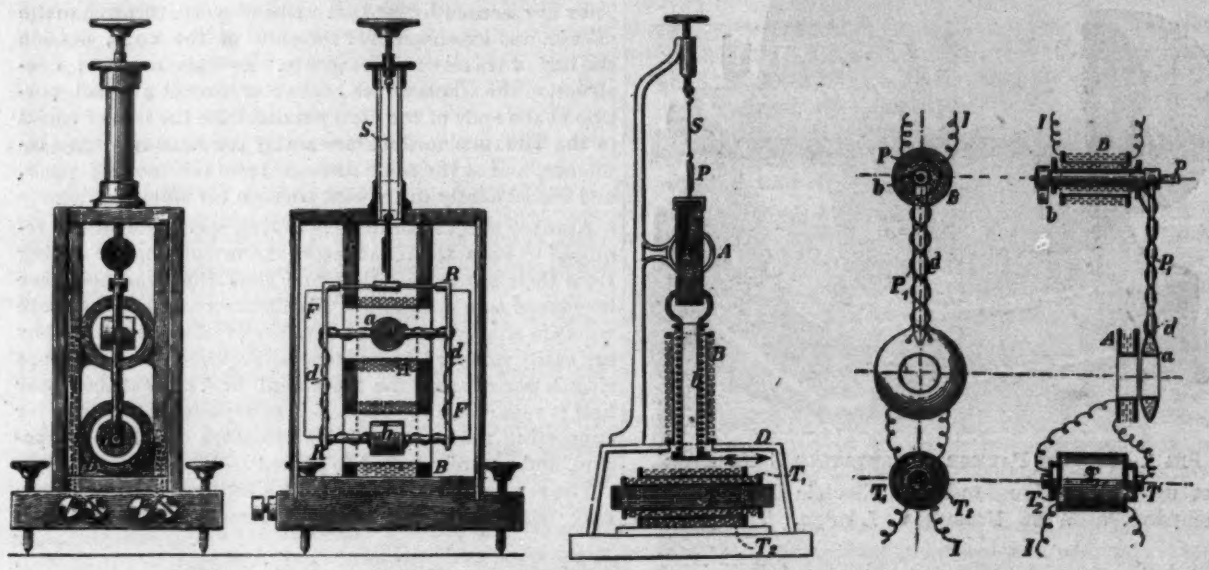
the side thrust being taken by collars, forged solid on the shaft at each side of one bearing only; double grooves are cut for throwing the oil into the collectors provided at each end of the main bearings. Mounted on this shaft is a hub of cast-iron, attached to the ring on which the magnets are mounted in such a manner as to prevent any magnetic short-circuiting. The rings on the shaft for collecting the exciting current are insulated from the shaft and from each other by ebonite washers. The brushes and holders are supported from the base plate. The driving pulley is of cast-iron, double web type, with turned grooves for seven 1¼-inch cotton ropes, diameter 40 inches. Fixed to the dynamo is also a pulley of suitable diameter for driving the exciter, turned with grooves for four ¾-inch ropes.

The exciter is a 12-unit series-wound inverted machine by Elwell-Parker, with drum armature, run at 800 revolutions per minute, and driven by ropes from the dynamo shaft.

Efficient means for tightening the driving ropes are provided, consisting of two cast-iron rails of heavy section, fitted at one end of each with forcing screws, provided with holding-down bolts for the dynamo, the nuts of which are of rectangular form and sliding in grooves formed in the rails. The bolts being thus applied from above are removable without lifting the dynamo. The two rails are securely tied together with cast-iron distance pieces. Similar arrangements are supplied for the exciter.

The approximate weight of the dynamos is ten tons, and of the exciter, one ton. All around the dynamos and exciters is a highly insulated platform of crossed floor boards set on joists, with bitumen between the two sets of boards and linoleum laid throughout. This platform is raised six inches above the general floor line.

The Lowrie-Hall transformer is of the "core" type as distinguished from the "shell." There are two sets of primary and secondary coils, laid horizontally one above the other. The core is formed of thin, broad sheets of soft iron insulated from one another by varnished calico, and the projecting ends of these plates are alternately bent up and down respectively, so as to complete the magnetic circuit, the whole being clamped together in a horizontal cast-iron frame. The Lowrie-Hall meter was fully described in our issue of Nov. 17, 1888.



FIGS. 1, 2, 3, 4 AND 5.—NIPKOW'S ALTERNATING CURRENT AMMETER.

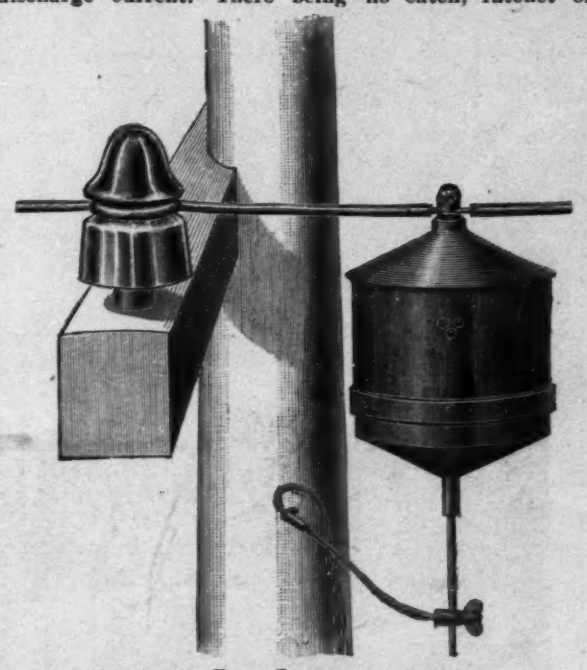
Automatic Pole Lightning Arrester.

It was recognized very early in the art that dynamos require protection from lightning discharges coming in from the line, and quite a number of devices, some of a highly ingenious character have been applied for the protection of the machines. But while the dynamo is no doubt the most important part of the plant requiring protection, it is evident that the lamps and other devices connected with the external circuit are liable to the same mishap as the dynamo, and although a burn-out in any one of them may not lead to serious inconvenience, the disabling of a number of lamps by lightning may at times prove very annoying, not to speak of the danger incurred by the extinguishing of lamps in crowded streets.

To protect the apparatus external to the station, therefore, the Electrical Supply Company, of Chicago, have recently brought out an automatic pole lightning arrester, which is illustrated in the accompanying engraving.

In many instances the lightning strikes the line at a distance quite remote from the station, divides both ways upon the circuit and runs into the station on both leads. The arrester is designed to protect from a half to three-quarters of a mile of line wire. Should the lightning strike the line it will run to the nearest arrester and be grounded automatically without interference with the lamps and without grounding the line. The dynamo current following the static discharge severs all ground connection and at the same time sets or places in position new discharge plates, which operation is repeated for successive discharges. As the static discharge comes on the line exterior to the station, very little damage can be incurred by the more delicate portions of the lamps, motors or other translating devices upon the circuit, and but a small percentage of them can be influenced at all.

The engraving shows the case, which is moisture proof, attached at its top to a line which is freed of insulation at this point for the purpose. At its bottom is an insulated rod and a flexible conductor running over to the ground wire, which comes up the side of the pole, and is connected to a good ground plate near the foot of the pole. The arrester has advantages over the ordinary station lightning arrester in that it is self-acting, and there is an entire absence of any element of self-induction, which has recently been shown to be so obstructive to the rapid conduction of the discharge current. There being no catch, ratchet or



AUTOMATIC POLE LIGHTNING ARRESTER.

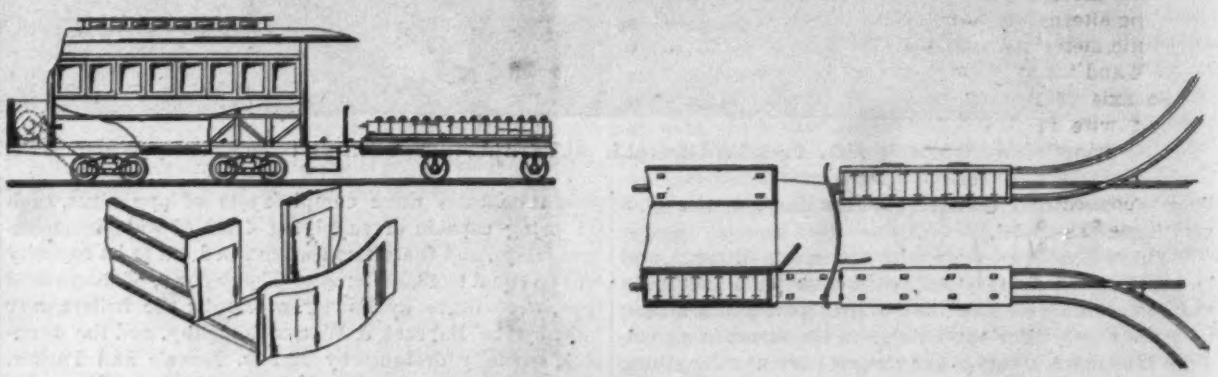
similar device the jar of the wind cannot disarrange or get the arrester out of order. Another advantage lies in the fact that it requires no constant consumption of energy to keep it in operation; there is no circuit through it and no energy enters it excepting at the instant that the static discharge is passing. The arrester is adapted both for arc and incandescent circuits of any length, and its use upon incandescent circuits does away entirely with the wink and constant strain upon the filaments of the lamps during thunder storms.

New Method of Inserting Storage Batteries in Cars.

The usual method of placing the storage batteries in position beneath the seats and removing them is from the side of the car, and to admit of doing so the sides or panels of the car between the top of the seat and the sill-pieces are loosely connected or hinged to the car-body frame so as to be removable from the car or dropped down out of the way, and the batteries are lifted into and out of the car. To admit of placing the batteries beneath the seats, however, the vertical and angular braces heretofore used between the posts of the car-body frame must be cut away or dispensed with, or otherwise the batteries cannot be placed in position beneath the seats; hence, it is said, the car-body is weakened at its parts requiring the greatest strength, and when so weakened it has to support and carry the large additional dead-weight of the storage batteries. Consequently, if the car be a street-car with the wheels in the centre, it is not as strong and durable as the usual form of the same, and, on the other hand, if it have trucks at its end to distribute the load the body is not properly braced and it sags in the middle, and it is not, therefore, as strong and durable as before.

To obviate these difficulties Mr. John A. Brill, the well known car builder of Philadelphia, proposes to place the batteries in position under the seat and remove the same from the end of the car. The accompanying illustrations, Figs. 1 and 2, show the manner in which this is accomplished under his patent. As will be seen, a door is made in one of the ends of the car adjacent to the seat and also a door or flap in the dasher in line with the door in the end of the car. There are also provided rollers or wheels in the car floor below the seats for a tracked platform, upon which the battery sections, properly coupled together, are placed, so that all the battery sections for one side of the car can be run under the seat at once, and at their far end circuit connections are so arranged that they automatically couple with and uncouple from the motor circuit when the battery is inserted into and withdrawn from its position beneath the seats.

As seen in the engraving, Fig. 3, the batteries are brought to the cars on trucks running on narrow-gauge railways, which branch off from the main track.



FIGS. 1, 2 AND 3.—BRILL'S METHOD OF MANIPULATING STORAGE CAR BATTERIES.

Alternating Current Ammeters.

Recognizing the difficulty connected with the use of the most generally employed instruments for measuring alternating currents, in which the current to be measured has to be conveyed to the moving part by contacts, Herr P. Nipkow has devised a system in which the current indications are obtained by means of secondary effects, *i. e.*, by secondary currents induced in independent coils from neighboring conductors carrying the current to be measured.

On this principle Mr. Nipkow constructed in July of last year the apparatus illustrated in Figs. 1 and 2, which, though roughly put together, was quite serviceable. The instrument, which is described in the *Elektrotechnische Zeitschrift*, consists of two large coils of wire *A* and *B*, and the small ones *a* and *b*. The two latter are connected by a frame-work to the suspension fibre *S*, and the frame *R* is provided with fans *F*, the whole being movable within the coils *A* and *B*. The planes of winding of the coils are as follows: *a* at right angles to *A*; *b* parallel to *B*; *a* and *b* are connected in a closed circuit by means of the wires *d*; the suspension wire *S* consisted of German silver wire one-tenth millimetre in diameter.

In the experiments for which the apparatus was constructed, *B* was connected in the battery branch and *A* in the galvanometer branch of a Wheatstone bridge. After a balance had been obtained in the resistances by means of a galvanometer, the continuous current in the battery branch was replaced by an intermittent current, and the apparatus then gave a deflection, because an electro-magnet was included in one of the sides of the branches of the bridge, whereas the other branches consisted of resistances without self-induction. According to the position of the electro-magnets in the branches, the deflection was either positive or negative, and was greater or smaller according to the amount of self-induction in the respective branches.

The manner in which the apparatus operates will be readily understood; in consequence of the self-induction of the electro-magnet, alternating currents are created in the coil *A* (galvanometer branch); the coils *b* are subject to the inductive action of the intermittent currents in *B* (battery branch), and therefore transmit alternating currents to *A*. Acting in conjunction with the simultaneous secondary currents in the coil *A*, this imparts a positive or negative motion to the suspended coils according to the relative sequence of the currents in the coil *A*; the sensitiveness of the apparatus can be increased by the insertion of an iron core in the coil *b*.

In the arrangement shown in Fig. 1, the coefficient of mutual induction between B and b, and hence also the current strength in the insulated independent suspended coils a b, grows smaller with the increase in the deflection, by which it is evident a damping of the motion is obtained, and the sensitiveness of the apparatus is reduced. This difficulty is overcome by an arrangement shown in Fig. 3. The coil b of the suspended coils a b, when a deflection takes place, turns within B and about a common axis, so that the coefficient of mutual induction between B and b remains the same under all conditions. The coil A is preferably arranged within a, a and b consisting of a few turns of heavy wire. For practical measurements a transformer T is placed in the base of the instrument, the primary coil T_1, of which, is placed in series with the coil B, and through which the current to be measured passes. The coil T_2 is closed upon itself. If it is desired to measure the power delivered by the circuit in volt-ampères or watts, T_1 is placed in series with the circuit, and B in shunt with the same. B in that case must be of high resistance.

If the apparatus shown in Fig. 3 is employed merely for the measurement of current strength, T and B are placed in series; then the deflections are directly proportional to the current strengths, provided the suspension wire S consists of a single wire or a silk fibre in connection with a torsion spring. Otherwise the current strength is proportional to the tangent of the angle of deflection if a suspension or bearing without resistance is employed, and a definite direction be given to the deflected body by means of a permanent magnet. In the arrangement shown in Fig. 3 this might best be accomplished by making the mirror P of steel and magnetizing it. In this form the apparatus might be designated an alternating current tangent galvanometer. For reading, a pointer Z could be attached to a b, and the top of the case D provided with a glass scale.

The principle of the application of secondary currents created in independent movable bodies for the purpose of measuring alternating currents can also be employed in the electric meter of Dr. Aron. The arrangement shown in Figs. 4 and 5 may be employed for that purpose. Here P is the axis of rotation and P_1 the pendulum rod; a is a coil of wire in the form of a lens-shaped pendulum bob. The primary coil B is arranged around the axis of P and the coil b so that P b may swing freely; b is directly connected with a by the wire d. Behind a, and in the same axis, the coil A is placed, which is in direct connection with the secondary coil T_2 of the transformer T. The alternating current to be measured is passed into the primary coil T_1 of the transformer and into the coil B. The coil b sends current into a of the same direction as the currents which coil T_2 sends into the coil A; hence an attraction is set up between A and a, which is manifested in an increase of the rate of the pendulum vibration.

The Thomson-Houston Electric Railway at Des Moines.

Our illustration shows a view of the electric railway at Des Moines, which was equipped by the Thomson-Houston Electric Company, of Boston, and which has been in operation since Dec. 20, 1888. This line is seven and one-half miles in length, and at present there are eight cars in daily operation, each equipped with two 10 h. p. Thomson-Houston motors. The road is double track and overhead construction has been used throughout.

The power plant consists of a 100 h. p. engine and boiler and a Thomson-Houston 80 h. p. generator. The operation of this road during some severe weather has done much to dissipate the doubt regarding the feasibility of running electric cars during snow storms. About Dec. 28 a severe snow storm visited Des Moines, nearly one foot of snow falling. Of the three tramway lines in Des Moines, steam, horse and electric, the last named was the only one which operated on schedule time, making regular trips every fifteen minutes, which was certainly very flattering to the system.

FIG. 1.—THOMSON-HOUSTON ELECTRIC RAILWAY AT WICHITA, KAN.

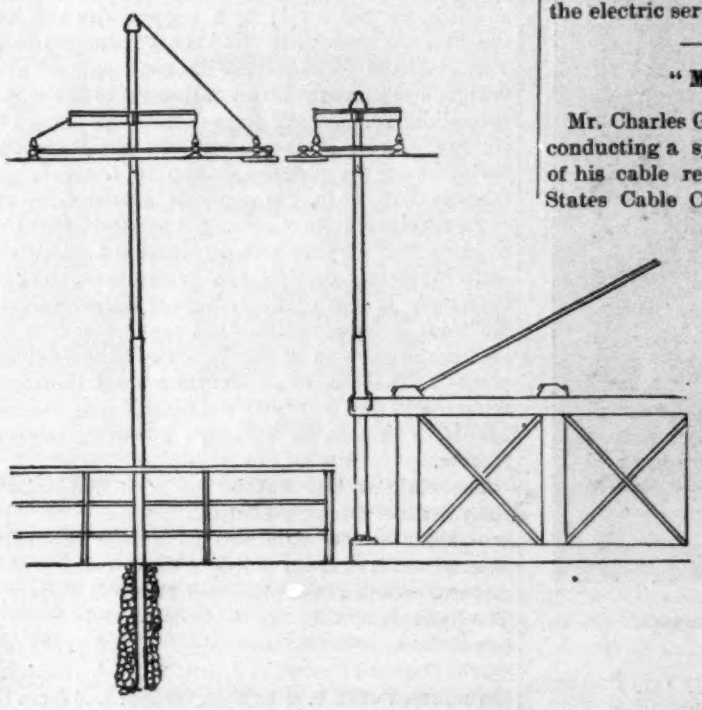
Thomson-Houston Electric Roads at Cambridge, Mass., and Wichita, Kan.

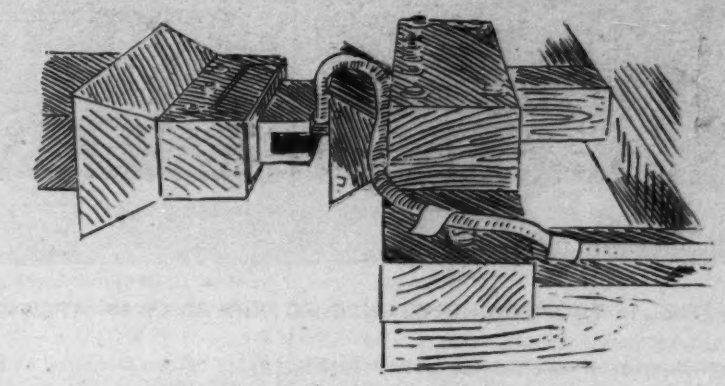
The equipment of the Cambridge division of the West End Street Railway, between Bowdoin Square, Boston, and Harvard Square, Cambridge, is now completed, and the cars are operating on schedule time. Work on this line was commenced Nov. 20. The construction presented some electrical problems of no slight difficulty, but they have been successfully solved. The most important of these was the drawbridge, which necessitated some special construction in order that the opening of the draw should have no effect upon the operation of the cars on either side of it. The automatic switch which is used there is shown in the accompanying cuts Figs. 3 and 4, p. 146. The main circuit runs under the draw from side to side, through a special cable, which is joined to the overhead wires on each side, thus making the circuit complete. Besides this, an auxiliary cable is used supplying the current on the short stretch of overhead wire on the draw, which is independent of the hore wires. This cable is brought up to the centre pie on which the drawbridge revolves, and is connected to one part of the automatic switch which is stationary on the pier. On the revolving part of the bridge is suspended the other half of the switch, which is in turn connected to the short strip of overhead wires on the draw itself. When the drawbridge swings in, the switch is closed and the current can reach the overhead wires, and can be supplied to the cars which are crossing. When the draw is opened, the connection at the switch is broken, as it is not necessary to have the current on the draw. This connection is entirely independent of the main cable which runs underneath the draw from side to side. The rails on the draw-bridge are connected the same as those on the street by a copper wire and four poles, one at each corner, to hold the conductors in position. The overhead construction at each end of the draw-bridge, and upon the draw adjacent to these ends, is of special design. A long piece of iron pipe is used to secure rigidity, and to it the curve ears are fastened, and to each end of the pipe, as shown in the cut, are placed frogs so that when the draw is closed these two frogs come together, thus rendering it impossible for the trolley to jump the wire in passing from the conductor on the main bridge to that on the drawbridge. The overhead conductor is reinforced by feeder wires which are run out from the power station and connected to it in proper places, and serve to maintain a constant potential at all points on the line, or to prevent a break in any place interfering in any way with the operation of the cars. The possibility of such an accident, however, is exceedingly remote.

The work as laid out by the West End Railway Company for the Thomson-Houston Company to accomplish with their electric cars, was to handle the entire North avenue and Arlington business as it centred at Harvard Square, between that place and Bowdoin Square, Boston. The business on this line is exceptionally heavy, in fact, one of the heaviest in Cambridge. The first car for Boston leaves Harvard Square at 6:10 A. M., and thereafter every ten minutes until 6:10 in the evening; and from that time until 11:20 fifteen minute intervals are made. This means a total of 93 round trips per day. Beginning with the first trip on Saturday morning, Feb. 17, but seven trips were lost. In view of the fact that the traffic was very heavy indeed, that it rained heavily all the afternoon, and that the drivers were unfamiliar with the cars, this record is certainly a remarkable one. On Sunday the regulation 72 trips were made without a miss. Monday, Tuesday and Wednesday, the regulation week day 93 round trips were made without a miss; and as everything is working there is no reason, after this date, why such a record should not be continued. By the round trip, of course, it is understood that the electric car towed a North avenue car. On some trips 200 passengers are carried. The total number of passengers carried per day is about 7,000. There was no little surprise and admiration manifested at the manner in which the car took its load of more than 150 passengers up the 5½ per cent. grade on Cambridge street, and the ease with which the car was stopped and started upon it. Considering the fact that Cambridge street is one of the most crowded thoroughfares in the city of Boston, being the

THOMSON-HOUSTON ELECTRIC RAILWAY AT DES MOINES, IOWA.

main street over which all the Cambridge business from Boston travels, it is astonishing that such a record as the above could be made; and it reflects the greatest of credit upon the engineering skill and perfect workings of the machinery of the Thomson-Houston Company. Taking the performance for one day of these motor cars, as before stated, they made 93 round trips. On account of delays through the steam railroad crossing, or heavy teams, or the drawbridge being opened, on some days it was necessary to put out eight or nine cars at a time. On Monday seven cars easily handled the entire business, making a total mileage of 604 car miles; this





FIGS. 3 AND 4.—AUTOMATIC ELECTRIC RAILWAY SWITCH AT DRAWBRIDGE, CAMBRIDGE, MASS.

is, per electric car, 86 miles a day. If to this is added the same mileage of the tow car, a total car mileage was made of 172 miles through the agency of one electric motor car. Figuring on the usual mileage basis that a horse can make, it amounts to the fact that one electric car did the work of 32 horses. Mr. Hapgood, the superintendent of the Cambridge Division of the West End road, stated that he would not want to agree to maintain, as a regular thing, the work done by these seven electric cars with any less than 212 horses. Such figures as these, and such a record on a road of this description should certainly convince street railway men of the possibilities of the system in use.

The electric railway at Wichita, Kan., shown in the cut, Fig. 1, has been in operation since the latter part of December, and in a manner which is most flattering to the system in use there, the Thomson-Houston. Report comes to us, as noted recently, that a copper brush has been in continuous use on one of the electric motors on this road for a period of sixty-five days, during which time a distance of more than 4,300 miles was covered. This is, without question, the longest time that a motor brush has been in continuous use, and speaks the highest praise for the one which is used.

Ryde Pier Electric Railway.

Although the electric railway on Ryde Pier, England, cannot be described as an engineering enterprise either of great magnitude or of profound difficulty, yet it is one of the earliest electric tram lines in that country, and one which both technically and commercially has given entire satisfaction from the very first.

In a recent issue, the London *Electrician* publishes the following comparative statement, showing the actual results of working by horses and by electricity.

It is well to note that the number of passengers carried is obtained from the number of tickets issued, but in addition to these all persons holding railway tickets to or from Ryde, and all persons holding passes and free tickets, are entitled to use the tramcars.

Half-Year Ended 31st December, 1885.

TRAM-LINE WORKED BY HORSES.

Hire of horses and drivers		£34	0 0
Conductors' wages		31	4 0
Repairs and incidental expenses		10	0 0
Oil for lighting cars		1	10 0
		£176	14 0
Cash receipts	£350 18 7		
Passengers carried	72,802		
Train miles	5,288		

Receipts per train mile, 15.9d.; expense per train-mile, 8.02d.

Half-Year Ended 31st December, 1886.

TRAM-LINE WORKED BY ELECTRICITY.

Gas consumed in engine: 289,200 feet (cubic) at 3s. 11d. per 1,000, less 5 per cent.		£53	16 0
Wages of conductor and boy		39	16 0
Wages of engine driver and assistant		64	6 6
Repairs and incidental expenses		15	18 7
		£173	17 1
Cash receipts	£532 2 1		
Passengers carried	113,733		
Train miles	6,435		

Receipts per train mile, 16.9d. Expenses per train mile, 6.48d.

The Electric Road at St. Catharine's, Can.

A statement has been printed in various papers lately to the effect that owing to troubles with snow, the use of electricity on the Van Depoele road at St. Catharine's had been given up, and that the company had gone back to horses. Inquiry demonstrates the untruth of the statement. Mr. E. A. Smythe, the president of the road, writes as follows: "It is a malicious falsehood that we have gone back to horses. Our electric machinery is working first rate. We have had no trouble to speak of with the snow, and the public are entirely satisfied with the service." This is remarkable testimony to the efficiency of the electric service at a point so far north.

"Morse" Used on Long Cables.

Mr. Charles G. Burke, who for the past year has been conducting a systematic series of experiments and trials of his cable relays over the cable of the Direct United States Cable Company between Rye Beach, N. H., and Halifax, N. S., has just returned from the latter station. He is said to have succeeded in satisfactorily demonstrating the fact that Morse telegraphy by sound is quite practicable over the longest cables and at a speed as great as, if not greater, than that of the mirror or siphon recorder.

On Sunday, Feb. 17, one of Mr. Burke's relays was for the first time tried on the main Atlantic cable of the Direct United States Company between Halifax and Ireland, a distance of 2,500 miles, and a local circuit and an ordinary Morse sounder were operated without difficulty. The make and break of the local circuit were just as prompt, firm and accurate as on any land line, and this without any increase of the battery power in daily use by the company in the operation of the mirror.

Mr. Burke is now having a sufficient number of instruments constructed to establish a complete circuit between New York and London, over which messages will be sent direct without the intervention of operators at intermediate stations, and received at their final destination by sound as is now done over land lines.

The Direct United States Cable Company are affording Mr. Burke every facility for the trial, perfecting and introduction of his system, and they have, it is said, an option for its exclusive control. The progress of the new departure in cable telegraphy will be watched with great interest, and we hope at no late day to be able to announce its success. A full description of Mr. Burke's methods cannot, however, be furnished until after foreign patents covering his invention have been secured.

FIG. 2.—THOMSON-HOUSTON ELECTRIC RAILWAY, CAMBRIDGE, MASS.

Multiplex Telephony on Long Lines.

Mr. D. S. Sinclair, engineer to the National Telephone Company, lately read a paper on the above subject before the Glasgow Philosophical Society. The lecturer described his paper as a *résumé* of what had been done, and what was likely to be done, in regard to this subject. He showed that in no way could multiplex be done on single wires as such, but by employing return loop circuit wires three sets of telephones could be used on two such circuits. In America four sets of instruments on two circuits had been tried, but this the lecturer condemned, holding that that system destroyed the qualities of loop circuits, while using three sets retained them.

Absolute Resistance of Mercury.

In a recent number of *Wiedemann's Annalen*, F. Kohlrausch publishes an account of a re determination which he has carried out, with elaborate precautions, of the absolute resistance of mercury. The method employed was Weber's method of damping, with some slight modifications due to Dorn. The result arrived at is that the resistance of a cubic centimetre of mercury at 0°C. is 94,060 centimetre seconds. In order to compare this determination with the B. A. unit, Mr. Glazebrook has compared one of the author's mercury standards with the B. A. unit in the Cavendish Laboratory, and finds that according to Kohlrausch's determination, one B. A. unit = 0.9866 ohm. This would give a length of between 106.2 and 106.3 for the column of mercury one square centimetre in section having a resistance of one ohm.

New Sprague Electric Roads at Cleveland, Lafayette, Ind., and Salem, Mass.

We illustrate on this page three of the new Sprague electric roads at Cleveland, O., Lafayette, Ind., and Salem, Mass., respectiveiy. They are all on the overhead system. The Lafayette road, Fig. 1, has been in operation about six weeks, and our cut shows one of the cars passing in front of Perdue University, one of the finest buildings in the city. The cars are lighted, as well as propelled, by electricity. Fig. 2 is a view of the road equipped by the Sprague Company at Salem, Mass., for summer traffic between that city and a watering place two or three miles away, known as Willows. The road is owned by the Naumkeag Street Railway Company, and it is understood to be the intention of Mr. C. F. Odell, the president, to add to the service this year and extend the line to Beverly. The road gave great satisfaction last summer in spite of such heavy loads as our cut exhibits—loads to which four horses had often proved unequal.

In Fig. 3 a view is given of the Sprague road on Euclid avenue, Cleveland. The road went into operation about a month ago, and has carried a large number of passengers, who are delighted with the new motive power and the quickness with which the cars can be started and stopped, their speed and the ease with which they mount the grades and round the curves. Citizens of Cleveland say that is a delightful sensation to ride in one of these cars, and it is especially advantageous in the evening, when the cars are lighted by electric light.

The equipment of this road is first-class in every particular and is very similar to that of the famous Sprague electric road in Boston, Mass. The poles used are of iron throughout the entire length of the line, and the overhead work is especially neat and unobtrusive, making the whole line work unobjectionable to even the most critical eye. The power station for generating the necessary current is one of the most complete of its kind in the country. It is fitted with Edison dynamos, Armington & Sims engines, etc., and everything is so arranged that its capacity can be easily quadrupled without changing the line of machinery. Since the road has been in operation, it has been visited by a large number of delegations, from all sections of the country, of railroad men who have inspected the operation of the road with a view of introducing electricity upon their own lines. The East Cleveland Railway Company have afforded them every opportunity for so doing, and the result has been that a large number of contracts since the opening of the road have been awarded to the Sprague Company by street railway managers, after inspecting the successful operation of the road at Cleveland.

FIG. 1.—SPRAGUE ELECTRIC RAILWAY, LAFAYETTE, IND.

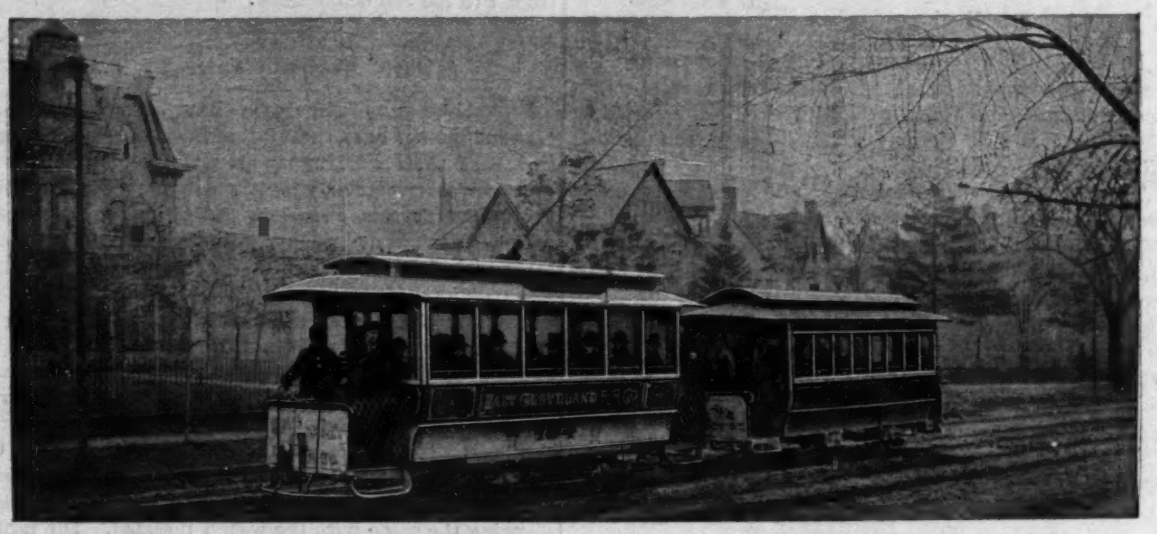


FIG 3.—SPRAGUE ELECTRIC RAILWAY, CLEVELAND, O.

In a recent snow storm which occurred in the city of Cleveland, the tracks were all covered to a depth of six to eight inches, and the horse railways in that city were delayed in their trips, and only ran intermittently. The electric road, on the other hand, made regular trips, plowing its own way through the drifts and successfully demonstrating the advantages of electrical over animal power. The Sprague Electric Railway and Motor Company are now equipping snow plows, to be operated by powerful electric motors, for this road, so that no snow, however deep, will be able to stop the running of the cars. It is estimated that these electric plows will clear the tracks more quickly than an ordinary plow drawn by a dozen horses.

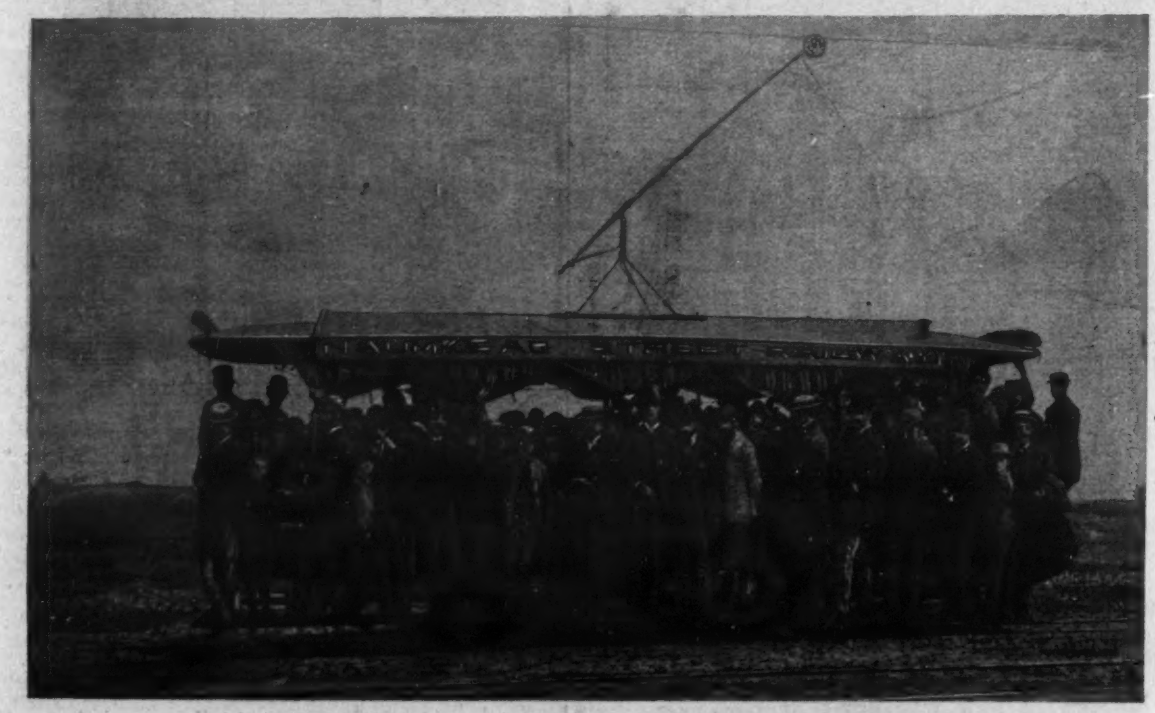


FIG. 2.—SPRAGUE ELECTRIC RAILWAY, SALEM, MASS.

Incandescent Lamps for Army Signaling.

Some important signaling experiments were carried out at Aldershot in the presence of Lieutenant-General Sir Evelyn Wood and Colonel F. C. Keyser, C.B., inspector of army signaling for the United Kingdom. The main object was to test a new signaling electric hand lamp made by Messrs. J. P. Rees & Co. The flashes are caused by the making and breaking of contact between the battery and the lamp, and they are for all practical purposes instantaneous. The lamp will burn from ten to twelve hours without having to recharge the battery. The night was far from being a satisfactory one for long distance signaling, being hazy and showery at intervals. Mr. Rees and party took up a position on Foxhill, near the Great Flash, a distance of about three miles. At this distance, except during clear intervals, the oil lamp could not be seen, or was only just discernable with the field glasses, whereas the electric lamp shone out clearly, and messages were transmitted with the greatest ease.

An Analogy in Distribution.

BY W. S. M.

Analogies between electrical and mechanical devices are often of great value in giving a clearer insight into both. Among the many such given by various writers I do not remember ever having seen the similarity pointed out between the distribution of electricity by all the various transformer systems, so called, and the distribution of gas, steam, etc., by means of steel mains conveying these under a large pressure and distributing them into buildings through "reducing valves." Some of the points of similarity may be arranged thus in parallel columns:

ELECTRICAL.	MECHANICAL.
1. Small wires with great difference of potential between them.	1. Small pipes with gas or steam, etc., under great pressure.
2. Saving in cost of wire on account of high potential used.	2. Saving in cost of pipe on account of great pressure used.
3. Transformers which reduce the difference of potential to what is safe for commercial purposes.	3. Reducing valves, which lower the pressure to what is safe for commercial purposes.
4. Secondary wiring large in proportion to energy transmitted on account of lower potenial used.	4. Inside piping large in proportion to quantity of gas or steam conveyed on account of low pressure used.
5. Possible danger from fire or to life due to high potential.	5. Possible danger of large quantities of gas or steam escaping through breaks or leaks due to high pressure, causing explosions, etc., in case of gas, fires, etc.
6. Danger from insulation between primary and secondary breaking down and high potential coming within reach of users of current.	6. Danger from reducing valve failing to work properly and allowing full pressure to pass to the other side of it, causing pipes to break, etc.

A Few Telephone Questions.

To the Editor of The Electrical World:

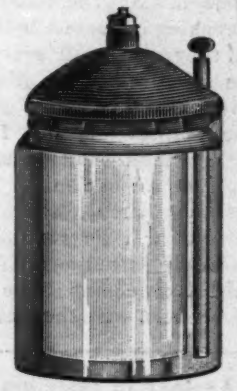
SIR: I have made a telephone, the receiver of which is similar to that used in the Bell system, having the steel bar magnet and coil, with diaphragm. (1) Will this same combination be sufficient for the transmitter? (2) Would the carbon-button transmitter work better than the magnet and coil? (3) Should there be any difference in transmitter and receiver as regards size of wire? (4) Does the size of wire and resistance have any effect on the result? (5) Will using this instrument render one liable to prosecution for infringement of patent rights? By answering through the columns of your valuable paper you will greatly oblige a constant reader. A.

LIMA, O.

ANSWER: (1) Yes. (2) A far better effect is obtained by the use of the carbon transmitter. (3) Under ordinary conditions, no. (4) Yes. Probably the best effect will be obtained with a winding not exceeding 75 to 100 ohms. (5) As the Bell patents have thus far been fully sustained, the making of such an instrument would render the user liable to suit for infringement.—EDS. E. W.

The Redding Battery Cover.

Every one who has used the Leclanché Battery must have been annoyed by the salts creeping over the top of the glass jar and running down the sides to the shelf below, making a short circuit, which greatly shortens the life of the battery, and necessitates frequent cleaning and renewal of the solution. Hence a battery will sometimes run but a few weeks without renewing, whereas if properly protected from evaporation, it would remain in good condition for more than a year without any attention whatever. The engraving herewith shows a very successful device to cure this defect. It consists of a soft rubber cover, which is very easily secured to the top of the glass



A NEW BATTERY COVER.

jar by an elastic band, and which entirely prevents evaporation. The covers have been in use for about a year, and are found to answer the purpose perfectly. The battery remains quite dry and free from climbing salts, and does good service many months longer than when unprotected. This cover is made by the Redding Electrical Company, of Boston.

The Hookham Electric Meter.

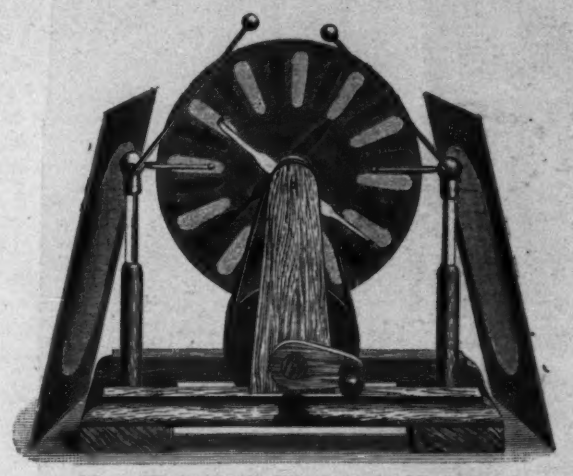
In connection with the distribution of current from the central station at Leamington, Eng., there is employed a meter designed by Mr. Hookham, which is illustrated in the accompanying engravings taken from the London *Electrician*.

The meter consists essentially of an electro-motor doing work against Foucault currents, under conditions in which other retarding influences are negligible. When this is the case, and the armature carries the current to be measured, the field remaining constant, the speed of the armature will vary directly as the current. For the work done is proportional to the square of the speed; the brake-force varies as the speed, hence the speed will be proportional to the driving force, which, again, in a constant field, is proportional to the current to be metered.

The engravings, Figs. 1 and 2, illustrate a meter for a thirty-light installation. The armature sections are built

FIG. 1.—THE HOOKHAM ELECTRIC METER.

up on a copper disc, the connections passing spirally round the edge of the disc. The disc and armature rotate together between the poles of the magnet. These are of cast-iron, the magnet bars of tungsten steel being contained in a brass tube beneath. The reduced ends of the armature spindle roll on the uppermost wheels of anti-friction trains, and a commutator in which mercury contacts replace spring brushes, and which is practically frictionless, is an important part of the device. Iron is not used in the armature, so that magnetic drag does not enter as a disturbing cause. The motions of a worm-wheel driven by a screw-thread on the armature spindle are transmitted to the counter. At present the magnets are fitted with a short-circuiting bar, whose distance from the cast-iron arms of the magnet can be adjusted. The object of this arrangement is that if the field is found to fall off it can be reinforced by removing the bar to a greater distance. In practice this has proved to be a superfluous precaution, as, after many months' testing of a considerable number of meters, in no case is there the slightest indication of the field falling off. The cause of this constancy of field is no doubt to be found in the fact that the air-space resistance is extremely small, and the magnetic circuit consequently almost closed. A further advantage of this closed circuit is that it is impossible to tamper with the field by means of external magnetism, especially as the whole apparatus is inclosed in a



NEW WIMSHURST ELECTRICAL MACHINE.

stout iron case. This case is glazed at the part opposite the dials, and need not be removed, even at the quarterly visits of the meter inspector.

The most striking peculiarity of this meter is to be found in the remarkably slow rate at which it can revolve without losing proportionality. It has, therefore, a wide range, one size measuring from .4 to 20 ampères and another from .6 to 40 ampères. The loss of energy in this case is only about one-tenth per cent., but where a somewhat higher rate of loss of energy is not objected to—as, for instance, for station service—a range of as much as from 1 to 250 can be obtained.

A Novel Magnetic Watch Protector.

Probably many of our readers have learned to their cost that magnetism has a great influence on the rate of a watch and that those working in the vicinity of dynamos and other apparatus embodying powerful magnets must make provision for this disturbing influence on their time-pieces. Various means have been proposed for thus obviating the effect of magnetism in watches, such as their construction of non-magnetic material and again the interposition of a shield, such as iron, which shall act as deflector of the magnetic lines of force, so as to lead them around the delicate parts, which are usually influenced. One of the most simple appliances which have been devised on the latter plan is the "insulated watch protector" recently brought out by the Newark Watch Case Material Company, of this city. Our illustrations show the appliance, Fig. 1 being the case alone, and Fig. 2 showing the same with the watch inserted. The protecting case is made of two sheet iron bowls neatly japanned or plated, and lined with velvet. The two halves are hinged together and a spring keeps them closed when

FIG. 2.—A NOVEL MAGNETIC WATCH PROTECTOR.

the watch is placed in the pocket. The protectors are made in various sizes and can evidently be applied to any watch.

A New Wimshurst Machine.

It is undoubtedly known to most of our readers that the Wimshurst machine is a great improvement over the old type of plate glass machines, in which the electricity was obtained by friction, and in many respects also over the Holtz and similiar influence machines. In the Wimshurst machine the element of friction is dispensed with, and a spark is obtained by induction or influence. The machine is self-exciting and generates electricity as soon as the wheels are revolved, a steady supply being given as long as the handle is turned, and this, whatever the condition of the weather may be.

The present form of machine which is illustrated in the accompanying engraving has been devised by Mr. E. T. Birdsall, of this city. The machine has 8-inch plates, and with Leyden jars, or rather plates, which are shown in the engraving, gives a good one-inch spark. It will be remembered that the machine was illustrated last week in our Patent Record.

This machine, on account of its simplicity, cheapness and practicability, will be a great boon to students and experimenters, as with it experiments with static electricity may be performed, and much instruction may be derived. It is certainly a most instructive and useful piece of apparatus for any one who desires to study this subject. The

FIG. 1.—A NOVEL MAGNETIC WATCH PROTECTOR.

E. S. Greeley & Co., of this city, have undertaken the manufacture of this machine.

A Correction.

To the Editor of The Electrical World:

SIR: Will you please amend our advertisement by substituting the word "main" for "sole" on the headline reading "completely depriving the defendants of their sole defense." My attention having been called to the several statements made in this advertisement I have carefully perused it and find with the above exception they are properly expressed and substantiated by the facts. Having thus disposed of the only error in the notice by frankly admitting it, I leave to others the definition of the word "sustaining."

NEW YORK, Feb. 29, 1889. EDW. H. JOHNSON,
President Edison Electric Light Co.

The Burning Out of Armatures.

To the Editor of The Electrical World:

SIR: In the article on "The Burning Out of Armatures," near the bottom of page 99 in THE ELECTRICAL WORLD of Feb. 23, 1889, the following statement appears:

"It is claimed by many that the power absorbed by a dynamo is expended in driving the *armature-coils*, and that the *armature-coils* are entirely free from magnetic

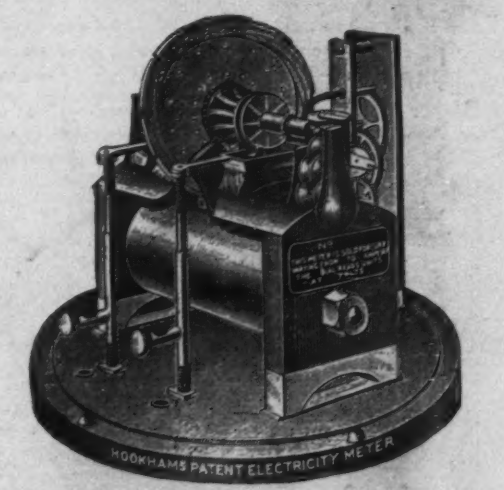


FIG. 2.—THE HOOKHAM ELECTRIC METER.

drag," etc. Near the top of the same page it reads: "Experience has, however, demonstrated * * * that the power applied to the pulley is spent in driving the *armature coils* and that the *armature coil* absorbs no power," etc.

It will be seen that the above statements are absurd and inconsistent with one another. The following is the correct version in the instances cited: "It is claimed by many that the power absorbed by a dynamo is expended in driving the armature *core*, and that the armature *coils* are entirely free from magnetic drag," etc. And again, "Experience has, however, demonstrated * * * that the power applied to the pulley is spent in driving the armature *coils* and that the armature *core* absorbs no power in itself," etc.

I call the attention of your readers to these corrections, as the point sought to be made will otherwise fail to have been brought out. H. FRANKLIN WATTS.

CHICAGO, Ill.

The Electric Duel.

Not long since, as our readers will remember, quite a sensation was caused by the challenge issued in this city for an "electric duel." The challenger proposed that he should subject himself to the continuous current while his opponent should submit to the alternating current; and the result was to be accepted as a final determination of the relative safety of the currents. The idea of this odd duel has traveled abroad, and has taken the form indicated in our illustrations, on the adjoining page, reproduced from *Paris Illustré*. These quaint cuts explain themselves, and our readers can decide, just as they wish, whether the current that turned the combatants into incandescent gas was the one current or the other.

Edison-Westinghouse Litigation.

The following is a special dispatch from Pittsburgh, of Feb. 16: The contest between Edison and Westinghouse was renewed in the United States Court to-day. Judges McKennan and Acheson were on the bench, and there was an unusually large attendance of persons interested in the fight between the two corporations, both of which claim to have the exclusive right to furnish electric illumination to the people of the United States. The case was brought into court on a bill filed in the interest of the Westinghouse Company against the McKeesport Light Company, an Edison off-shoot, to restrain the latter from infringement on letters patent alleged to be held by the plaintiffs. On Saturday the case came up before Judge Acheson on a motion made by the Westinghouse Company to fix a time for a final hearing on the motion for a permanent injunction. Mr. Walter K. Griffin, of New York, representing the Edison Company, asked that at least two months' additional time should be allowed to take evidence. Congressman John Dalzell, of this city, on the part of the Westinghouse interest, opposed the motion, but it was finally determined to give the Edison

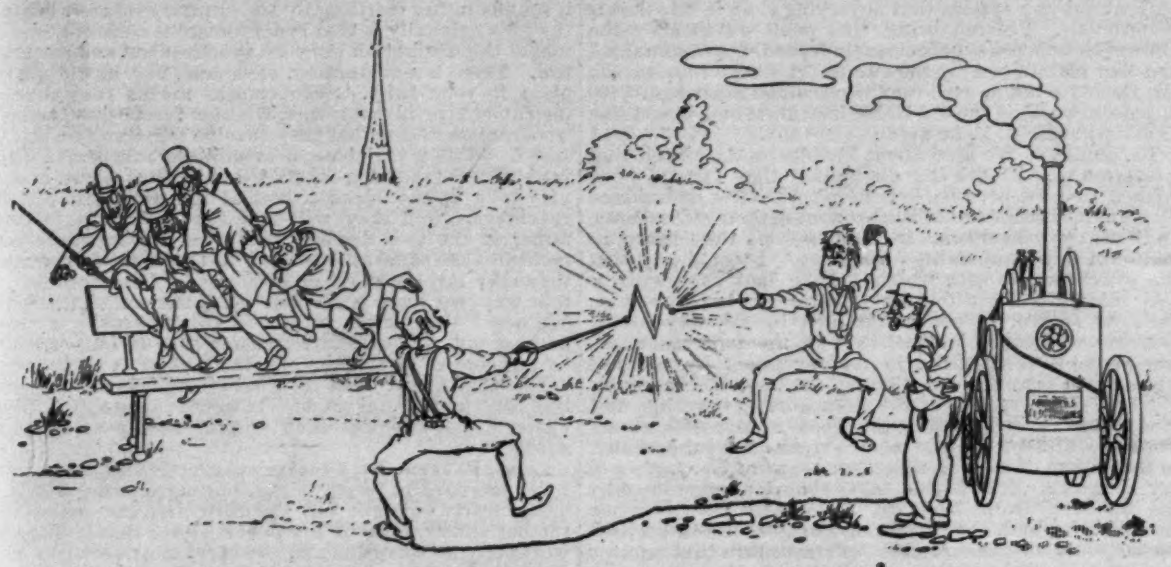


FIG. 2.—A CRITICAL MOMENT IN THE ELECTRIC DUEL.

Company one week in which to prepare affidavits in support of the motion for an extension of time.

When the court opened to-day there was present a long array of legal talent. On the part of the Westinghouse Company there appeared Messrs. Duncan and L. E. Curtis, of New York; John Dalzell, William Bakewell, George H. Christy and T. B. Kerr, of this city; while for the Edison Company, Grosvenor P. Lowrey, Richard N. Dyer and Walter K. Griffin, all of New York, were present. The argument was opened by Mr. Griffin, who made the formal motion that the Edison Company should have at least two months' time in which to prepare evidence in defense of the suit. In support of his motion he read affidavits from Professor Barker, of the University of Pennsylvania; President Johnson, of the Edison Company; and Judge Noah Davis, of New York. There was also an affidavit from Mr. Thurston, the principal counsel of the Edison Company, who was prevented from being present to-day because he was engaged in a suit in Chicago in which the Pullman vestibule car patents were involved. The affidavits set forth that it would be unjust to the Edison Company to force a decree on the testimony given in the case against the McKeesport Company, because in closing the evidence in that case they had acted upon advice that there was nothing to answer in the bill. The affidavit of Professor Barker asserted that the claims of Sawyer and Man had not been sustained, and that the invention had been anticipated before the latter's patent had been issued. President Johnson in his affidavit stated that the company was anxious to have a final and complete decision made on the rival claims. In the McKeesport case, however, under legal advice, no testimony was presented, except a copy of an article published in a New York paper, in which it was shown that Edison had claimed to be the inventor of the device for lighting embraced in the Sawyer-Man patents at least two years before the patents were issued to the latter. After Mr. Griffin had concluded the reading of the affidavits, Congressman Dalzell asked if it was necessary to present any affidavits in opposition to the motion. Judge McKennan said that if the Westinghouse Company had any affidavits, they should be given now, as it would close that branch of the proceedings. Mr. Duncan, of New York, said that they had some affidavits, but they would be more in the nature of argument against the extension of time for taking testimony. The affidavits were made by Mr. Kemple, a former examiner in the Patent Office; Frank L. Pope, and Mr. Broadnax, the principal attorney for Sawyer-Man. Messrs. Kemple and Pope averred that the claims of Sawyer and Man had been sustained by the Patent Office. Mr. Broadnax in his affidavit gave a statement of the struggle between Edison and Sawyer and Man for the patent and cited the decisions rendered in favor of the latter. He also averred the policy of the Edison interest was to defer a final decision on the question involved. He claimed that the defendant should be held to the testimony and answer submitted by them in the proceedings against the McKeesport Company. Mr. Griffin argued at some length in support of his motion, and was followed by Congressman Dalzell in opposition. He said the question involved was whether or not the defendant, after having closed his case, should be allowed to open it up and go over the entire ground again. He said it was absurd to argue that a defendant, after electing to attack a certain point in the case, should be allowed to have another chance, because he failed to open up an interminable line of defense. The Edison counsel had advised the McKeesport corporation how to proceed, and as they thought they could prove a priority of invention in favor of Edison they rested their case. They should be held to that answer and should not be allowed further time. The court took the papers and reserved its decision.

It has now given a month's extension of time to the Edison Company.

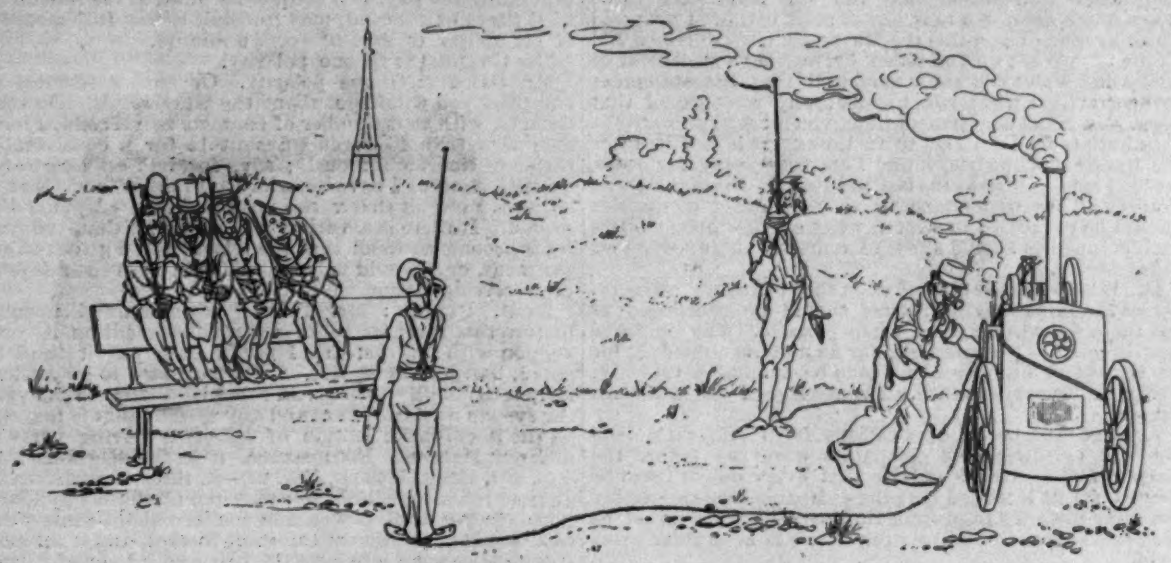


FIG. 1.—THE SALUTE IN THE ELECTRIC DUEL.

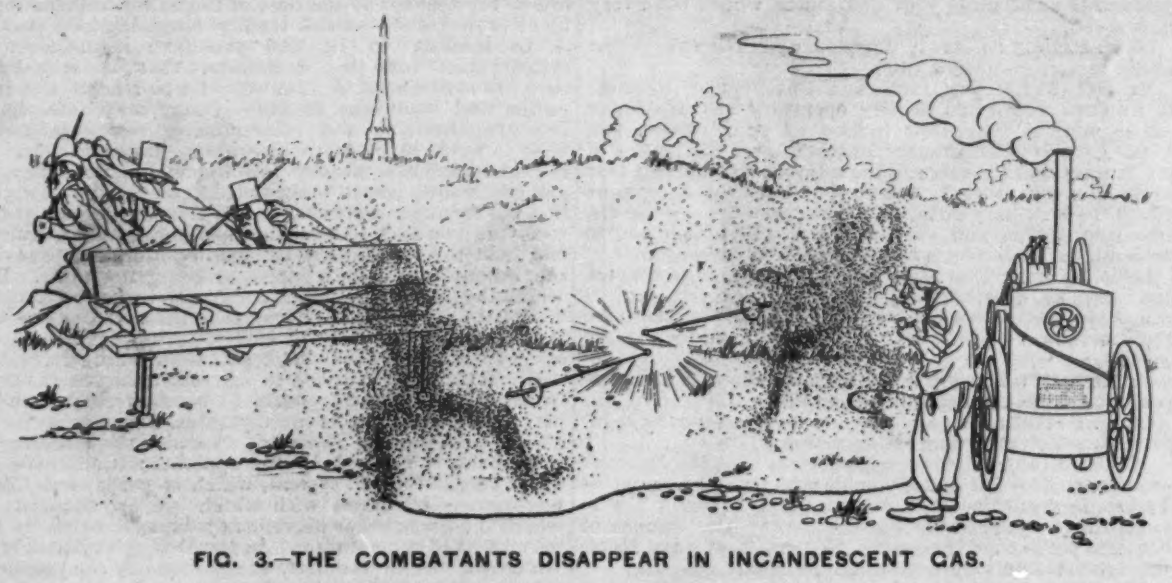


FIG. 3.—THE COMBATANTS DISAPPEAR IN INCANDESCENT GAS.

New York Board of Electrical Control.

The Board of Electrical Control met on the February 25. A letter from the United States Illuminating Company was read in which was expressed a belief that the subways would prove useless for electric light wires. The company, however, promised to make a thorough test as soon as their cable is ready. "I want it distinctly understood," said the Mayor, "that the forty-five days agreed upon for this test at the last meeting must not be entirely taken up in getting a cable. The test must be completed within that time. If it is not I shall take some action."

A communication was presented from the Metropolitan Telephone and Telegraph Company, which showed that 90 per cent. of the wires in the underground ducts are the property of the company. During the year 1888 the company removed, or had removed by the Bureau of Incumbrances, 200 poles and 700 miles of wire; they had drawn into the ducts 46 miles of 100-conductor cable, making 4,600 miles of wire at a cost of $140,640. The letter set forth the difficulty in making connections, and in securing the cable, and the fact that although the company was doing all that could be done, it would be impossible to complete the work before many months.

The Mayor said that too much time had been wasted already; the company knew all these months that the wires had to be put underground, and they ought to have been more forward with the work. Commissioner Gibbens said that so far as the Metropolitan Telephone Company was concerned he should be sorry to see them included in any sweeping resolution, as he knew for a fact that they were having an excellent cable made in Chicago with all dispatch. The Mayor said, "Let them put on more hands and get it done faster."

Mr. Gibbens said the subway was the future of the telephone company. They could not get on without it, and if the Board looked at what they had been doing in the past, and were doing now, he certainly thought it would conclude that they were worthy of some consideration. Mr. W. H. Eckert, the general manager of the company, said they were just as anxious to get the wires underground as the Board was, and were using every possible effort to do so. The Mayor said if the convenience of the public had been considered by the company the wires would have been down before. They certainly ought to be, for the company charged enough, and its revenues were immense.

Commissioner Gibbens, in appreciation of the good work done by the company in the past, and its palpably honest intentions for the future, seemed desirous of finding a point in its favor if possible. "Let us," he said, "take up some of these streets where the poles are most inconvenient to the public, and ask Mr. Eckert how long it would take to remove them; that line, for instance, in Sixth avenue below Twenty-first street?"

Mr. ECKERT: "It would take 60 days."

Commissioner GIBBENS: "How long would it take to remove the Sixth Avenue and Forty-second street line?"

Mr. ECKERT: "It would be quick work to get that line done in sixty days."

The Mayor proposed to give the telephone company 20 days, the same time given to the Western Union company; upon which Mr. Eckert explained that the Western Union wires were trunk lines, whereas the telephone company's wires are in lots of 6, 8, 10, etc. "We certainly," he continued, "will do the best we can; we cannot do impossibilities."

Commissioner GIBBENS: "They are certainly working in the right direction."

The MAYOR: When we say 20, 45 or 60 days they will be down pretty soon after that, depend upon it. We mean to fix a time, and for the companies to abide by it. There is to be no re-consideration or extension of time at the next meeting. When the time is up, the poles will come down, whether the companies take them down or not.

It was finally decided to give the Metropolitan Telephone Company and the Western Union Company 30 days within which to get their poles and overhead wires out of the streets where there are subways. The Manhattan Electric

Lighting Company applied for a new permit to put up poles on First avenue. Mr. Leslie, on behalf of the company, said that the new poles were for the purpose of connecting its east-side wires with those of the subway district. The Mayor said he was willing to vote for the application if the new poles were to replace others no longer to be used. Mr. Leslie said the company was going to take down 127 poles in Third avenue. Dr. Wheeler immediately arose and stated that the 127 poles were to be taken down because a new line of poles had been put up in Third avenue. Upon this the Mayor angrily addressed Mr. Leslie: "What do you mean by making a statement of that kind, when you know very well that the statement is incorrect. I want you to distinctly understand that when you make a statement here, you must be prepared to substantiate it. I am glad to see the expert is looking after the interests of the board, and I am very sorry for some words I said to him at the last meeting." The permit was granted on the understanding that no other companies should be permitted to stretch wires on the poles unless such companies should agree to remove existing wires on other streets.

Dr. Wheeler made a suggestion that in future all companies stringing overhead wires should be compelled to put them on existing poles when possible. The engineer was directed to prepare plans for an underground duct for the increasing number of cables to be run across the city, either in Twenty-seventh, Twenty-eighth or Thirtieth streets.

A large number of applications from telegraph, telephone and electric light companies were put before the board. Mayor Grant moved that every one of them be denied, for *he* intended that the companies should display the same industry in putting their wires underground as they had shown in finding subterfuges to keep them overhead.

The Mayor directed that the police should be notified just what permits had been granted, and, in accordance with the decision of the Board, Commissioners Moss, Hess and Gibbens called on Inspector Byrnes after the meeting and asked him to stop all work on old permits, and to cause the members of the force to allow action on new permits, the first of which had been issued that day.

The meeting adjourned toMarch 7 at 12 o'clock.

Meeting of the American Institute of Electrical Engineers.

We give below the very interesting discussion of the paper by Lieut. F. Jarvis Patten, on "A New System of Multiplex Telegraphy" read before the Instutute, and published in full in our issue of February 23.

Mr. C. O. MAILLOUX, in the chair: I would like to ask Lieut. Patten, how many contacts to the line he proposes to give for each Morse circuit, so as to make the circuit sufficiently continuous for the manipulation of the average Morse operator. I didn't catch clearly the number of pulsations per second that he proposed to apply to each branch circuit with his distributors.

Lieut. PATTEN: The question is certainly a very pertinent one, and one which cannot yet be answered with all the definiteness I would like to give it; but, in general terms, I would say the number of segments given to each operator necessarily depends upon the speed of the machine. I would simply say that we have four contacts in a line. We have made a sounder work with clear action, on an artificial line of course, at the rate of thirty words a minute. There are two things which determine the number of contacts to be given to any operator in the circumference of a distributor; one is the speed at which the trailer is driven, and the other is the amount of time that the trailer rests in contact with the segment. Four contacts give a good reliable result. That would give about 1,200 pulsations per minute.

Mr. P. B. DELANY: You say that the number of contacts that each operator would have, as a matter of course, depends on the number of revolutions of the distributor; not necessarily so because your distributor would have very slow speed.

Lieut. PATTEN: I say it depends upon the rate of the trailer in a given unit of time.

Mr. DELANY: If you increase the number of segments in a circuit connected to any operators' instrument, of course, with a very slow motion of your trailer, you would get the same number of contacts. The object of my inquiry was to ascertain the number of contacts that could be given to each operator, and at the same time afford the necessary duration of contact between the distributing trailer and each segment, and enable you to transmit currents over a line of considerable resistance.

Lieut. PATTEN: That is a refinement of the subject which can only be determined by prolonged experiment. I would say that with a few thousand ohms resistance we could get lower than $\frac{1}{100}$ or $\frac{1}{200}$ part of a second for a single contact.

Mr. DELANY: You say that with 1,200 contacts a minute you get a sufficiently continuous circuit?

Lieut. PATTEN: Yes; so far as our experiments have indicated, which are on an artificial line.

Mr. R. W. POPE: It is my impression that Mr. Delany's experience does not quite coincide with that of Lieutenant Patten, in regard to that contact, and I would like to hear what his experience has been as to the number of contacts per second necessary to permit of fast Morse manipulation on long wires.

The CHAIRMAN: I think it would be particularly interesting if Mr. Delaney would tell us his experience as to the maximum number of pulsations which can be maintained on a line of a given distance, and having a given static capacity—*i.e.*, what can be the number of impulses per minute before the static charge interferes with them to any great extent.

Mr. DELANY: My experience would lead me to believe, not to state it exactly but in a general way, that on a circuit of, say, 100 miles, from New York to Philadelphia, for instance, with perhaps 1,200 to 1,500 ohms resistance, and an iron wire of a capacity, probably, of 1½ or 2 microfarads, that about 500 impulses per second can be transmitted over such a line and received on segments corresponding in position in the circle on a circuit table, provided the trailers and the distributor are in synchronism and allowing a slight instant of time for the retardation of the circuit. If the retardation amounts to $\frac{1}{200}$ part of a second then the current sent at one segment in a particular position in the circuit will be transferred to the segment next in the direction of the revolving trailer, and especially so if the line is not cleared of its static charge. After each impulse has been sent into the line, the charge that is in the line delays the next initial impulse that goes into the line and delivers it in a segment still further removed at the receiving end. I have found that in the operation of Morse circuits—what we call good Morse circuits—it requires at least 35 or 36 impulses per second to make a smooth circuit, so that the operator manipulating the key, as is frequently done, at the rate of 12 to 15 times in a second, may transmit to the full measure of his ability, or say, 40 words a minute.

The CHAIRMAN: Of one polarity?

Mr. DELANY: Of one polarity. Or with a reversal of polarities you would get about the same result. On such circuits, with that number of contacts in a second, I have seen more than 40 words transmitted for a considerable period of time continuously; say, for half an hour, over circuits about as I have described. In order to do that, it requires a circuit that varies not more than $\frac{1}{100}$ part of a second. If there is a variation in excess of that, the currents become so weak that the relays would go out of adjustment, or it would be very sensibly felt at the relays at the receiving station.

Lieut. PATTEN: Mr. Delany has remarked upon a feature that it might be of interest to mention in connection with this system. I might have put it into the paper, but, as I have said, I did not care to go particularly into detail. There is an essential difference between the system as shown here and any system that is founded on the isochronous motion of different moving parts at different stations. For instance, if in the diagram, Fig. 5 (p. 107, ELEC. WORLD, Feb. 23)—if these were driven by an isochronous machine and were not absolutely synchronous, the two trailers would be inclined at the same identical angle of position at the same instant, and if an electric impulse were sent over the line, and it took any time to reach the other end of the circuit, it is evident that the trailer would have left the position where it was when the impulse started. In a system of this character where synchronism is maintained variable (you might describe it as transmitted synchronism), the trailer is just as much behind the initial one at the receiving station in time as it requires the current to reverse the line. These refinements are somewhat delicate, but if there is such a distinction it is evident that we have more chance of getting the current out in a system that is varying than in one that is isochronous. I merely bring this point out to show the difference between synchronism independently maintained and that maintained by the circuit. I would like to ask Mr. Delany what he used for the circuit he describes of 100 impulses, working the old Morse instrument; I would like to ask what E. M. F. he used?

Mr. DELANY: We used about 75 volts on the circuit that I referred to. I mark the distinction that Lieut. Patten wished to draw between synchronism that is maintained by machines that are not isochronous in their movements, and the synchronism, as shown on the board as maintained by transmitted impulses. I would say that the synchronism with which I have had experience is also maintained entirely by transmitted impulses, *i. e.*, the synchronism is not maintained in any way by the isochronous method independent of the two machines. One machine is corrected in its movement by impulses transmitted from the other end of the line; the receiving machine is corrected by the transmitting machine, and *vice versa*. The impulses are sent in opposite directions at different periods of the rotation of the trailer, so that if the current is sent over segment No. 1, we will say at station X, and if it takes the time represented by the distance from No. 1 to No. 2 segment to reach the receiving end, the correcting impulses which keep the instruments in synchronism will maintain that relation and position of the trailer. We have found it necessary in practice to maintain the instrument in synchronism on corresponding segments, where it was necessary or desirable to telegraph in opposite directions simultaneously. Because you will readily understand that if segments at each end of the line are connected to operator A, and one operator is sending to the other, and the instruments are in synchronism, and get the time of the impulses over the line as represented by the time of the trailer from one segment to the other—it will readily be understood that if A be sending to B, and the instruments are in synchronism for that condition, that if B should turn round and send to A, A would not receive the impulses that were sent to him. Consequently, we have two synchronizing and corresponding segments if we wish to work in opposite directions simultaneously. If the transmission is already done in one direction, then, as you can readily see, it makes no difference. So that you find the segment representing the time on the line at the receiving end and connect the operator to that segment and hold the instrument in that relation, the time on the impulse from each operator being the same. But where the time of the line is such as to make the transfer more than the margin allowed, than the variations of the instruments on the face of corresponding segments, you cannot work in opposite directions simultaneously.

Mr. KINTNER: I desire to call attention to the fact, which Lieut. Patten appears to have overlooked in his very good description of his apparatus, that it is, so far as I am aware, the first apparatus by which the isochronous movement is effected by the apparatus itself. We all know the old Casselli system, which is perhaps the first isochronous telegraph with which we are familiar, in which the isochronous movement is brought about by the movement of a pendulum. In Mr. Delany's system, with which we are all familiar, that is done by the harmonic principle. In Lieut. Patten's system it depends upon the peculiar phases of the alternating current generator and an alternating current motor of the same capacity or same efficiency, so that the two motors in all positions are dependent on the two phases in those positions. It was my good fortune last summer to make a somewhat extended set of tests and experiments upon Lieut. Patten's apparatus as to its efficiency and as to the iscohronous movements of the apparatus, and I found that the machines move uniformly in synchronism, and during the experiments a very interesting feature came out. We were using six sets of keys at each end of the line and I was testing with all the keys closed; at each end one key closed, and successive keys and various numbers of keys, to see that there was absolute synchronism. I discovered that when key No. 1 at section No. 1 was closed at each end, or any other number, that there was a faint response on section No. 2. I called Lieut. Patten's attention to it for the reason that I could not understand why it was so. At last, upon close examination of the brushes, I found that they were set slightly at an angle, so that as the brushes passed off section No. 1 they were slightly passed on to section No. 2, so that we had a response on the other section, which was an absolute proof of the synchronism of the two sections. I desire to call attention to the fact that the apparatus is capable of operation, as the Lieutenant has advised me, with an alternating current, in which it is possible, as I understand, to transmit messages over longer lines by reason of the fact that with an alternating current he is able to discharge the line more rapidly.

Mr. BATCHELLER: I would like to ask how many circuits are worked at one time?

Lieut. PATTEN: In answer to that question I have simply to say that our work has been entirely experimental, and I am not at liberty to state what the capacity of the system is, as it has not been tried in such shape that I should be warranted in stating it.

The CHAIRMAN: There is one practical question, I think which follows from the observations made by Mr. Delany and while he was speaking I rather misapprehended his statement. Mr. Delany states that on each pair of instruments you have some 35 pulsations per second in order to get Morse readings. Now, it so happens that in Mr. Delany's system he has the control of making those impulses of either polarity, because the battery is used at either end of the line and can connect either pole to the ground. If I understand Lieut. Patten's system rightly, the polarity of the impulses is alternating necessarily. Consequently, out of 35 impulses given to the pair of instruments, 17 of them will be of one polarity and the rest of them another. The question then occurs whether that number would be sufficient, or whether in reality it would not be necessary for him to have 35 of each polarity in order to effect good Morse readings.

Lieut. PATTEN: I have to say, in reply, that with our artificial line work, which is all we have done up to date, we have found that a far less number than 35 gives us very good results. In fact, the sounder acts very clear and sharp, and is up to a speed of transmission of some 30 words a minute, with some 15 pulsations per second, I should judge, as the average amount. It is impossible to tell accurately what number of pulsations there might be within 5 or 10 seconds. It varies from 15 to 25, I should think.

Mr. CROCKER: Lieut. Patten has spoken several times about variable synchronism. It is perfectly correct, but it sounds rather startling to the ordinary hearer, because the idea naturally is that synchronism is constant, and he makes the distinction between synchronism and isochronism. There is a distinction, of course, but he did not explain it very fully. Synchronism means that the two instruments revolve together, whether fast or slow, whereas isochronism means that they revolve together at a certain speed. With a variable synchronism he may start off two instruments revolving together at 100 revolutions, and he may take up the speed of both at the same time to 1,000 revolutions, and they will run synchronously just the same, as the two driving wheels of the locomotive attached to the same axle revolve at the same speeed; and they may revolve at 100 or 1,000 revolutions a minute. In that way we have a variable synchronism. I think the confusion that might arise from that is worthy of being pointed out. Lieut. Patten passed over it quite rapidly, but, of course, he is accustomed to look at it in that way.

The CHAIRMAN: That is a very important distinction that Mr. Crocker has made. It would appear that Lieut. Patten's system works both synchronously and isochronously.

Lieut. PATTEN: Mr. Crocker's distinction is quite correct. I had intended to bring it out, but perhaps did not do so quite clearly enough; but the distinction he makes is in further illustration of my paper, and I thank him. In working the instruments, we try to drive them at as uniform a rate as possible. I brought out this idea of variable synchronism as a distinguishing feature of the system, not as one that would necessarily be used to a large extent. If machines are running at a good speed, a uniform 100 or 200 revolutions per minute, they are isochronous machines, and of course synchronous also. But if their speed is changed, they are no longer isochronous for the time being; they are simply synchronous.

Mr. E. C. DAVIDSON: With your permission I should like to refer to one point. Mr. Kintner has suggested that the Delany system was based on an harmonic principle. I do not so understand it. I waited for some one to inquire into that; but as no one has done so, I will take the liberty of speaking of it. As I understand it, no question of harmonics is involved. The circuit breaker is employed to control the rotation of the motor at either end of the line; that circuit breaker, it is true, may be a fork; it may be a rotating wheel; that is entirely immaterial. There is no question of harmony about it. As the current breaker makes and breaks the circuit of the local wheel at the end of the line, what is after all a small electric motor, is rotated; that is, the passage of the pole on the disc or armature in front of a magnet coincides with the break in the circuit; that produces the rotation. Now the character of the impulse sent from one station to another merely modifies the circuit breaker; it slows it or accelerates it, and the two instruments are thus tied together; I do not understand that it is at all analogous to a harmonic telegraphy.

The CHAIRMAN: I think the distinction is quite right to a certain extent, but probably the word harmonic should have been changed to rhythmic. The action of the instrument in Mr. Delany's system has reference more to maintaining a certain rhythm in the pulsations than to their harmony.

Mr. KINTNER: I accept the suggestion. I simply wanted to convey the idea that in Mr. Delany's system, like Casselli's, the synchronism was maintained by an extraneous apparatus,—an apparatus extraneous from the motors themselves. Of course we are all familiar with Mr. Delany's inventions and know exactly what they do. We are aware that his inventions have wrought a wonderful improvement in multiplex telegraphy, and most of us, I presume, have seen them in operation. They were in operation here at the Institute some years ago, and there is no doubt about their wonderful success. I had no idea of calling them harmonic telegraphs. I merely wanted to bring out that distinction that they were controlled by extraneous means.

Mr. DELANY: I beg to assure Mr. Kintner that there is no discord produced by his allusion to harmonics. When Mr. Davidson referred to the making and breaking apparatus, I was going to perhaps make the description a little more clear by stating that it was an automatic circuit breaker originally, a tuning-fork in connection with what is known as the phonic wheel; that is, perhaps, where Mr. Kintner inadvertently got his idea of harmony.

My synchronous and my multiplex telegraph are based primarily on the very ingenious contrivances of Mr. Paul LaCour—his automatic circuit breaker in connection with a phonic wheel, an instrument that is moved by very fine increments. It moves over a little space at a time, and, consequently, has no opportunity for very wide variation before it is brought again to the centre of attraction by those recording impulses.

Mr. ABDANK ABAKANOWICZ stated that he had examined with great interest the synchronous devices of Lieut. Patten, and was impressed especially with the solidity and great power of the motors running in synchronism.

New Carbon Brush for Railway Motors.

The Thomson-Houston Electric Company have recently introduced an important improvement in their railway motor brushes by substituting for the copper brush one made of carbon. The copper brushes heretofore used allow the armature to rotate in either direction with perfect freedom, and are always maintained at an even pressure upon the commutator. They have always produced excellent results, but the experiment made with the carbon brush led to the belief that it possessed points of superiority over the copper, which supposition has since been found to be correct. As a consequence, carbon brushes are now in general use on all the railways using the Thomson-Houston system.

Reports concerning the wearing of this brush and its effect upon the commutator have been received, which speak very highly of its working. On some of the roads on which it has been used there are many heavy curves and grades, and the motors are called upon to do unusually heavy work. The reports regarding the brush say, without exception, that it has a longer life than the copper brush, and has a much better effect upon the commutator. One report states: "The commutator is in good order, and the carbon has been worn less than $\frac{1}{12}$ of an inch after running seven days of sixteen hours each. I have another set which is doing equally as well." Another states: "I have not taken out any of the carbon brushes yet. They have been running for nineteen days in two cars." A later report from the same place states: "I have one set of carbon brushes in car No. 1 twenty-seven days, and in that time the car has made 557 round trips, and the brushes are good yet for several days. The commutator lasts longer with the carbon brush, and the carbon brush lasts longer than the copper one."

Another report says: "On Dec. 5, I put carbon brushes into motors on car No. 11. They ran well, causing no sparking at the commutators. They caused the commutator to present a very smooth, glazed surface, which was quite black. I use no oil or other lubricant. They ran eight days of 18 hours each and covered an approximate total of 700 miles." A later one from the same place states: "On Dec. 31, I put carbon brushes into the car 'Nay Aug.' These brushes worked well, and have same effect upon the commutator as those on car No. 11. They were in use from the 3d inst. to the 20th inst., 16 days, and making an approximate mileage of 703 miles." Some of the latest reports state: "We have had brushes in use 65 days during which time the car covered a distance of 4,300 miles." "We have brushes in use 43 days, during which time the car covered a distance of 2,900 miles." These reports seem evidently to prove the superiority of this type of brush.

The following is quoted from the letter written by Mr. W. S. Wales, president of the Third Ward Railway Company, Syracuse, N. Y.: "We have given a trial to both the copper and carbon brushes, and are now using exclusively the carbons, as we consider them much more satisfactory, serviceable and economical, preventing a large wear on the commutators."

Necessarily, in a complete system all the small details must be worked out with care and attention. The commutator and brushes of an electric motor are vital parts, and anything which will add to their life must be considered as an important improvement.

These brushes, we are informed, will hereafter be used on all Thomson-Houston electric cars.

Municipal Management of Manufactures.

BY S. A. DUNCAN.

It has been a serious question among the wisest men in our country for a great number of years, whether the Federal Government had power in and by its Congress to develop and maintain internal improvements throughout the States and Territories, and whether it would be assuming the proper and wise use of the surplus funds in the treasury of the general government in thus developing rivers, inland streams, forests, railroads, and all other methods of traffic and commerce. After years of discussion, it was demonstrated that it was a serious problem whether the Federal Government had any such power; and the unwisdom of its exercise was finally conceded by all parties, for the obvious reason, that it would be not only a perversion of the functions of such government, but would work a discrimination against the people of our various States. The larger States, owing to the representation in Congress of their social and political interests, might so far dominate and control the smaller States as to render such a distribution or use of public funds a series of continued contentions, and possibly engender bitterness. More recently this question has arisen from the proposition to use the surplus funds for educational purposes throughout the States and Territories, but it has met with such little favor and such pronounced opposition as to have been almost wholly abandoned.

If not advisable, in theory and practice, for the general government—which exists for the purpose of promoting the morals and preserving the welfare of the nation at large—it certainly cannot be more advisable for the States, in their sphere, to undertake the same thing. And if not wise with the State, it cannot be commendable in any political subdivision of the State which we now denominate "municipal corporations."

As a matter of fact and of serious experience, Pennsylvania has gone through this experiment. Years ago, when private capital was exceedingly limited and individuals were unwilling to enter into combinations or corporations for the purpose of developing the resources of the State and carrying on internal ways, the State undertook—and did build—a system of canals, and, subsequently, of railroads, which were operated and controlled by the State until the year 1857 or 1858. During all the time the State thus controlled these internal improvements, and it necessarily depended upon its appointees and authorized agents. As financial investments they proved disastrous; their management was wholly and absolutely dependent upon the interest and the caprice of the political party in power. At every change in our state administration, appointees were named for the control of these vast interests, whose simple qualification was that of usefulness to his or their political party.

After years of trial, the State finally sold out these interests to a private corporation, organized for the purpose of constructing a system of railroads through Pennsylvania, from Philadelphia to Pittsburgh. The result was, that, under the management of that company, the canals and roads which had theretofore proved a source of annoyance and loss to the commonwealth, developed into one of the finest systems we have in our country to-day.

The experiment of the State and its subsequent action, show, at least, that improvements such as these did not reach their highest point of efficiency, under State or political control. Responsibility,—except of party—so cardinal to the question of fitness for control and management, was but rarely consulted. Under private enterprise, and with private capital, a wholly new and far better condition of affairs developed. Not alone was this enterprise started by private capital vastly beneficial to the State of Pennsylvania, but it resulted in creating a system of railroads and methods of transportation throughout the entire length and breadth of the State, so that every branch of industry, commerce, and trade, felt the beneficent effect of this individual enterprise. The people thus added to their comfort, to their wealth, and to their general prosperity; and, where properly managed, the stockholders—representing men, women, and children, in all parts of the State—had a certain return upon their investment, and were assured that the money so subscribed would be faithfully and well managed.

No city in the State, which has undertaken any peculiar system looking to lighting and heating, or any other public measure, has succeeded any better than the State. In almost every instance where private capital has been invested, and where the management of these private enterprises has been wholly controlled by the stockholders and directory, these cities have had more certain and successful advantages than could possibly arise under city control and management. There is not alone inefficiency and want of responsibility, frequently arising where a great municipal corporation has the control of any such industry, but experience has shown, most frequently, waste and extravagance, or such inefficient management as to amount to a serious taxation upon the people.

That in which the public at large has an interest, such as taxation, must necessarily be managed by a few public officers or agents, and not infrequently they, for the first time, through political favoritism, are called upon to manage affairs of which they are entire strangers. One experiment of this kind is apt to lead to another, in which the credit of the city is virtually pledged for indemnification against loss. In almost every instance, where a city in this country has become a subscriber to, or indorser upon, the stock and obligations of private corporations, such as railroads, the result has been disastrous, leading, not infrequently, to almost total bankruptcy of such municipal corporation. The city of Pittsburgh, with which I am more familiar than any other, is still laboring under the burden of indebtedness arising from this unfortunate subscription to some of these corporations, whose management was under the control of persons outside such city, and depreciated stocks and guaranteed bonds have been an incubus on that city, and upon many others.

If it be true that a city endorsing even for a private corporation, made up as some of these railroads are, suffers so greatly, it must be equally true that a city itself owning and controlling such interests would find itself in an equally embarassed condition.

The result of this experience is to demonstrate the unwisdom of municipalities undertaking any other purpose, or engaging in any other business than that of its sole and pure charter duty. And so long as such city confines itself to looking simply to the public welfare in its internal arrangements, such as police, etc., it not only largely promotes the safety and welfare of the people, but insures economy, and with it lightened burden of taxation. To depart from this safe rule, so firmly based upon experience and being to-day so widely discussed, is to invite serious danger, if not disaster. There is no other rule upon which a municipal government can more safely act than by following its charter, and through such charter encouraging in every legitimate way the investment of capital by private individuals in all industries through which come the happiness, the welfare and the prosperity of each and every community. If, when individuals invest their capital in such industries there is a guarantee that their affairs will be carefully, prudently and economically managed, the city itself is safe, the corporation is benefited, and through individual benefit of the corporation comes the benefit to the community at large.

It is doubtful whether, to-day, if we depended upon municipal corporations for our light, our heat, our rapid communication, our facilities for the supply of water and all that enters into the prosperity and contentment of the cummunity, they would ever have existed.

Wisdom would seem to suggest that every community controlled by charter ought to invite the citizens of such community to invest their capital in all legitimate systems of industry, the true principle being, as we believe, to have such municipality guard itself against needless and arbitrary encroachment upon any of the rights of such private corporation. Community of interest can readily be secured, and with it there ought to be a co-extensive development of the private and quasi-public corporation.

Appreciating the general principles I have announced, all the States in this Union have sought, in all proper ways, to promote these industries, and in nearly every State a system of law has been promulgated for the incorporation, regulation, control and encouragement of such corporations. The result is, in Pennsylvania at least, that almost any body of men may assume all the rights and duties and be subject to all the restrictions of these corporate laws, and feel absolute assurance that, so long and so far as they comply with these statutes, they have immunity from loss, as they have from any unjust discrimination on the part of the State, or of any portion of the State, against them. The result is, security of capital and a clear, well-defined pathway, within which they may walk and develop their industries, and the assurance, that, in proportion as such industry commends itself to the welfare of the people, they will have a return upon their investment, as well as the satisfaction of knowing that their enterprise is appreciated by their fellow-citizens. Without this legitimate aid, capital would remain stagnant; or, if invested, would, not infrequently, be in mere bubbles, started for the purpose of filching from the unwary and unsuspecting their own means, and thus, under cover of law, falling but little short of public robbers.

In addition to the general law found upon the statute-books of most States of this union, but especially in Pennsylvania, the law-making power has discovered the necessity and advisability of providing for the incorporation of certain special branches of industry; and, in order to invite investment of capital and to foster the same, has conferred on these corporations special privileges and immunities. Under what might be called this special legislation some of the most important corporations of Pennsylvania have been brought into being, and are now operating to-day. In them are invested enormous sums of money; almost every branch of industry affecting the people has been touched and benefited by them, so that the pecuniary advantage coming to the workman and to the manufacturer is beyond computation. Labor itself has been lightened, capital more generally diffused, homes have been secured, communities have become more firmly settled, and the comfort of the people of the State so largely developed as to be inestimable. Thus, we have heat and light, and gas and water companies, in almost every village of the State; and in order that the people might have brought to their own homes these vast advantages the State has said to the capitalist investing his money: "If you do so we will give you, for a given period of time, and until your earnings shall amount to a certain percentage per annum on your investment, absolute immunity from competition; that you shall have, within the limits of the territory embraced by this village, or borough or city, the exclusive right of supplying this commodity to the people of such place, until you are thoroughly reimbursed for the risk you take on the capital you have invested." Under this beneficial law, in almost every instance, men who have invested their capital have had a safe and reliable return upon the investment, whilst the people have had their happiness, comfort and prosperity so largely promoted that there does not live in the State to-day a man who has come in contact with such benefit who would be willing to have the statute otherwise than it is. This, then, shows not alone the sagacity of the law-making power, but presents a powerful argument on the part of the citizens of the utility and desirability of such industries, and the encouragement of others to go and do likewise.

* Prepared for the National Electric Light Association, Chicago, Feb. 19, 20 and 21.

Mr. Kapp on Alternate Current Machinery.

Our London correspondent sends us the following interesting sketch of an important paper: On Tuesday evening a paper was read by Mr. Gisbert Kapp at the Institution of Civil Engineers on "Alternate Current Machinery," there being a very large attendance. The paper dealt with alternate current dynamos, motors, and transformers. The author evidently essayed to do for alternate current machinery what he accomplished two years ago for continuous current dynamos in his now classical paper upon that subject, which was read before the same institution. It will also be remembered that in the spring of last year Mr. Kapp read a paper before the Society of Telegraph Engineers on transformers, in which he developed a graphical method of treatment. He now applies this same method to the consideration of alternate current dynamos and motors. This leads him into some rather complex, not to say impossible looking diagrams, where it would be out of the question to follow him in this letter. Perhaps one of the most interesting and important results which he obtains is the following: If we calculate out the E. M. F. of an alternate current machine by applying to it the now well-known formulæ for continuous current dynamos, there will then be a certain numerical coefficient by which the E. M. F. thus found must be multiplied in order to obtain the actual mean alternating E. M. F. of the machine. The value of this coefficient, K, depends chiefly upon the relative width of the field magnet poles and space between, and also upon the amount of the surface of the armature which is covered with wire. The following table gives the value of K for different cases:

1. Width of poles equal to pitch, toothed armature and winding concentrated in the recesses..... $K = 2.000$
2. Width of poles equal to pitch, smooth armature and winding spread over the whole surface..... $K = 1.160$
3. Width of poles equal to pitch, smooth armature and winding covering only one-half the surface..... $K = 1.635$
4. Width of poles equal to half the pitch, smooth armature and winding spread over the whole surface..... $K = 1.635$
5. Width of poles equal to half the pitch, smooth armature and winding covering only one-half the surface..... $K = 2.300$
6. Width of poles equal to one-third the pitch, smooth armature and winding covering only one-third of the surface..... $K = 2.830$

According to the ordinary sine formula the coefficient is, $K = 2.220$, and this agrees fairly well with case 5. which is the most frequently met with in actual practice, The investigation of motors was made also to apply to the problem of parallel working, and we are now for the first time shown how to determine from theoretical considerations beforehand, whether any two machines will or will not work in parallel under conditions of stable equilibrium. Mr. Kapp incidentally recalculated the results given by Prof. Ewing for the amount of heat wasted in the cyclic (or reversed) magnetization of iron. Prof. Ewing's results were given in ergs per cubic centimetre, but it is more convenient to have them in watts per ton, as in the following table which refers to annealed wrought iron, the numbers of alternations per second being 100:

Induction.	Watts per ton.	H. P. wasted in heat
2,000	650	.87
3,000	1,100	1.48
4,000	1,650	2.21
5,000	2,250	3.02
6,000	2,900	3.89
7,000	3,750	5.03
8,000	4,450	5.97
9,000	5,550	7.43
10,000	6,650	8.90

On the question of frequency, which is of considerable practical importance in the application of alternating currents, Mr. Kapp thought that the time had hardly yet come when theory could pronounce with confidence as to the most advantageous figure. He, therefore, thought it best to compare the practice hitherto adopted and to strike a mean. Thus Ferranti uses 67, Lowrie-Parker 84, Mordey 100, Zipernowski 42, Kennedy 60, Kapp 80, Westing-

house 133. Taking the average of European practice, the frequency is 73 or 8,750 reversals per minute, while the American practice is 16,000 reversals per minute. This large difference may, to a certain extent, be accounted for by the general preference of European engineers for machines running at moderate speeds; but even when making due allowance for this circumstance, it can hardly be assumed that, had actual practice shown the value of a very high frequency, electrical engineers would not have found means to obtain it. As a matter of fact, most maker of alternators have started with a very much higher frequency than they have finally adopted. The paper concluded by a description, illustrated by diagrams, of all the more important alternators at present in the market.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, March 4, 1889.

Removal.—I note the removal of Mr. A. B. Laurence, agent for the patent cotton leather belting of the Underwood Manufacturing Company. Mr. Laurence's new office is at No. 1A, Platt street, this city.

Increase of plant.—The United States plant in the Mutual Life Insurance building in this city, at present consisting of four 250 light dynamos. is to be changed by the substitution of four 550 light machines, run by two Straight Line engines. The United States Company is now wiring the Girard Life and Trust Company's building in Philadelphia for 1,200 lamps.

Primary Battery Electric Lighting.—I understand that Mr. John H. Hapgood, formerly connected with the Harlem Electric Lighting Company of this city, has gone into pushing a new primary battery for electric lighting, and claims that the battery he is handling is the cheapest and most economical yet devised. As I understand, the same is said to be the invention of a Philadelphia man.

Storage Battery Patents.—The Electrical Accumulator Company, of this city. have just issued a neat little pamphlet in which they discuss some patents recently granted for improvements in secondary batteries. They take up patents issued lately to a number of inventors and discuss their relation to the patents owned by the Accumulator Company itself. The little print will undoubtedly interest those connected with this branch of the industry.

Personal.—Mr. Henry Hine, the active general agent of the United States Electric Light Company, with headquarters in this city, has been appointed the general division agent of the Westinghouse Electric Company for New York, Pennsylvania, New Jersey, Maryland, Delaware and the District of Columbia. Those who are aware of Mr. Hine's long experience and his capabilities in the field of electric lighting, will readily concede that the Westinghouse Company has made a very desirable acquisition to its ranks.

The Electric Light on Long Island.—Electric lighting is coming to the fore in a large number of towns on Long Island. I understand that Jamaica will soon want a big incandescent plant, Babylon, which already has an electric light plant run by the Babylon Electric Light Company, is also looking around for incandescent lighting, as is Bayshore. The thriving little town of Riverhead will also increase its present arc plant and put in an incandescent.

Proposed Electric Railway Across Long Island.—The scheme has more than once being proposed of shortening the trip across the ocean by transporting passengers by rail across Long Island, and going aboard ship at the farther end of the Island. It is claimed that probably six hours and more could be saved by this route. In connection with this plan, there has recently been talk of building a railway to cross Long Island from Port Jefferson, on the east side, to Patchogue, on the south side. This road, which is to be run by electricity, is designed particularly to bring passengers from the eastern states to the ocean. It is proposed that the generating plant be placed at Port Jefferson, as coal is cheap there.

Anti-Friction Journal Bearings.—The long runs which dynamo machines have to make necessitate, in the first place, continuous lubrication, and, secondly, a journal bearing which shall offer the least friction to the revolution of the shaft. A metal which has been specially designed for this class of work is Post's "Zero" metal. A number of tests made with this metal in comparison with other anti-friction compositions has shown the same to have a far less co-efficient of friction and to keep the temperature of the bearings down to its lowest limit. Among those who have tested the metal and are now using it are the Edison Machine Works, the Westinghouse Machine Company and a large number of other machine builders.

Mr. C. J. Hirliman, the inventor of the battery now being placed upon the market by the Improved Patent Porous Cup Battery Company of this city, recently showed me some varieties in sizes and styles of his new battery, besides the regular sizes of Leclanché made by that company. The improved battery is made with a glass cover, which can be sealed around as desired. The company also makes special batteries in any desired sizes required for medical or experimental purposes. I was shown some of these cells which were three inches high and two inches square. Mr. Hirliman has had set up in his office a set of the regular improved batteries for over a year, during which time it has fed a 2 c. p. lamp. I was informed that these cells have, on some occasions, been left in circuit with the lamp from Saturday until Monday, and the batteries are still furnishing current.

Electricians at the Inauguration.—No ceremony can nowadays take place in which the electrician does not take some part with more or less prominence, and the presidential inauguration is no exception to the rule. A special electric light plant was erected in the Pension building to illuminate the ball-room, and the result was a most pronounced success. As noted by me some time since, an excursion was organized, consisting of a special train of Pullman palace sleeping coaches. This train left Jersey City at 10 P.M. Saturday, arriving at Washington the following morning, where it was side-tracked at a point near the Capitol building and remained during the whole period of the inauguration ceremonies. Among those who took part in the excursion were the following: M. D. Vail, of the Long Distance Telephone Company; Frank Fisk, of the Metropolitan Telephone Company; Gen. C. H. Barney and daughter, New York; Jos. Cavanagh, of New York; C. O. Baker, Jr., H. D. Stanley, of Bridgeport; E. A. Leslie, of the Manhattan Electric Light Company; Col. John Jamieson, of the Subway Company; W. J. Lang, of the Brush Electric Light Company, and the Committee of Arrangement, which consisted of Messrs. John A. Seely, H. R. Ronk, Geo. W. Odell and John Parr, Jr. Great credit is due to Mr. Seely, the president, for the success of the undertaking.

The New Gibson Storage Battery.—In a recent visit to the works of the Gibson Electric Company at 775 Greenwich street, this city, I was escorted through the various departments by Mr. C. P. Gibson, the inventor of the battery which bears his name. Your readers will no doubt have noted the recent granting of a patent to Mr. Gibson for a new electrode, consisting of a metal plate having loops raised from its surface so that the active metal covering the surface extends under the loops which act as a support to the active material. The adaptability of these plates for the purpose intended is at once apparent upon inspection, and the cost of manufacture has been reduced to a minimum. Mr. Gibson first showed me the new mould which casts the plates. The molten metal is cast into the mould, which is placed upright, and after it has been allowed to cool for a few seconds, a lever at the top forces out the die which holds the plate. The latter is then taken out of the machine which separates the metal plate from the die, and the cast plate is taken to a press, which at one movement cuts off the lugs, which leaves the plate clean and ready for the application of the active material. All this work is done on the main floor of the building, where from 400 to 500 plates are turned out in a day. The second floor of the building is devoted to applying the active material to the plates and to other work. The terminals for the plates are cast in one strip, with holes at regular distances apart, so that the strip fits accurately over the lugs left on the plate for that purpose, and which extend above the terminals, so that they can be sweated together by a blow-pipe. Another part of the floor is devoted to testing the batteries and preparing them for shipment. Several large United States generators are employed for this purpose, run by Schieren belts. Mr. Gibson has also brought out several new appliances to be used in connection with the battery circuits, among which is an instrument designed to be placed in the circuit, which will automatically cut out the battery in case of accidental interruption of the current.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, March 4, 1889.

The Marr Construction Company.—This well-known Pittsburgh company has established branch offices in Boston in the Hathaway Building, No. 620 Atlantic avenue. Mr. Norman Marshall will have charge of the agency.

Boston Electric Club.—On Monday evening, March 4, the regular monthly meeting of the club will be held at the new rooms, No. 7 Park street. Amendments to the constitution and by-laws submitted at the last meeting will be finally acted upon, and other important matters will come up for action.

The Standard Electric Company, of Vermont, has some of its workmen engaged in the installation of an isolated incandescent light plant at the Hargrave mills, Fall River, Mass. This company will use its own system—dynamos, lamps and other apparatus—in this installation. Six hundred lights will constitute the initial plant, which will be increased at an early date.

New Electric Light Station.—The Waterbury Electric Light Company has just finished its new station, and will commence moving the equipment of the dynamo and steam plants this week. The removal of the machinery will prove a venturesome undertaking, as it will be necessary to move everything from the old to the new building between daybreak and sundown of the same day.

A Popular Engine.—The McIntosh, Seymour & Company's engine is being rapidly introduced into New England. The selling agents, Messrs. Grant, Pearson & Co., received orders the past week for one of 100 h. p. for the Bristol, (R. I.) Electric Company; one of 200 h. p. for the Brookline (Mass.) Gas Light Company (compound condensing), and one of 250 h. p. for the Great Falls (N. H.) Electric Company.

Self-Registering Speed Indicator.—The steadily increasing demand for Heath's patent self-timing and self-registering speed regulator is remarkable, considering the short period this meritorious instrument has been on the market. The Eddy Electric Manufacturing Company, Windsor, Conn., manufacture this speed indicator, and orders for it now in hand are so numerous that additional workmen have been employed.

Holtzer & Cabot, manufacturing electricians, factory at Brookline, Mass., and salesrooms at 111 Arch street, Boston, have purchased the machinery, unfinished stock and good will of Mr. A. L. Russell's manufacturing business, formerly carried at No. 109 Court street. Mr. A. L. Russell, although having given up the manufacture of electrical goods and instruments, will do repair work in these lines and guarantee first-class work.

"Long Distance" for the Connecticut Capital.—Mr. W. S. Crofut, general inspector of the Southern N. E. Telephone Company, has a force of men at work at the Connecticut State House connecting up all the business departments with the Telephone Exchange in Hartford for long-distance work. Okonite wire will be used for inside connections, and between the Capitol and Exchange cables manufactured by the American Electrical Works will be used.

Mr. A. L. Russell, whose electrical establishment at 109 Court Street, Boston, was destroyed by fire recently, has leased an entire floor at No. 160 Sudbury Street, a few doors below the old stand, where he will continue the electrical supply business. I made note of this last week. He has saved from the fire several thousand dollars worth of electrical goods of various kinds and these will be sold at a great sacrifice. Many of the goods, including valuable instruments are only slightly damaged.

Thomson-Houston Railway Work.—The Thomson-Houston Electric Company has recently closed contracts for equipping the following roads: Newton Circuit Line, Newton Mass., 10 cars; Rochester Electric Railway Company, Rochester, N. Y., 8 cars, 7 miles; Colerain Avenue Street Railway, Cincinnati, O., 8 cars, 2.66 miles; Vine Street Railway, Kansas City, Mo., 6 cars; Metropolitan Street Railway, Kansas City, Mo., 8 cars, 2.25 miles; Omaha Motor Railway Company, Omaha, Neb., 10 cars, 5 miles.

Increase of Capital.—The Connecticut Legislature has granted the petition of the Thomson-Houston Electric Company to increase its capital stock to fifteen million dollars. Mr. William J. Clark, of Hartford, Conn., one of the company's agents, deserves great credit for the energy and ability he manifested before the Legislature in behalf of the interests of his company. Mr. Clark received valuable assistance from Mr. D. S. Simmons, one of the promoters of the Danielsonville (Conn.) Electric Light Company.

Dinner and Lecture.—The second club dinner of the year by the members of the Boston Electric Club will take place at Young's Hotel, on Wednesday evening, March 6, at 8 o'clock. After dinner Dr. Moses Greeley Parker, of Lowell, Mass., will address the club on "Peculiar Rotary Motions Found in Lightning and other Electrical Currents." This address will be based upon two lectures given before the Electric Club of New York and the Society of Arts of Boston; but many new data and many new and interesting illustrations have been added.

The Union Glass Company.—Spacious offices and sample rooms have been established by this company at No. 36 India street, Boston, under the management of Mr. John P. Gregory. The company's factory at Somerville, Mass., is under full headway, and a large force of workmen are kept busy from morn till night. This company is making all kinds and shapes of arc globes and incandescent shades. It has begun the manufacture of incandescent bulbs suitable for any system. Mr. John M. Mulcahy has been appointed traveling representative of the company. It can be safely and truthfully stated that the product of the Union Glass Company bears an enviable reputation.

The Thomson-Houston Electric Co. report the following sales of electric light apparatus: Rockland, Me., 30 arc; Atlanta, Ga., 1,000 alternating; Troy, O., 600 alternating; Mobile, Ala., 500 alternating; Macon, Ga., 500 alternating; Woburn, Mass., 50 arc; P. J. Noyes, Lancaster, N. H., 50 incandescent; T. J. Stewart, Bangor, Me., 50 incandescent; H. W. Smith, Bangor, Me., 50 incandescent; Alliance, O., 25 incandescent; Faribault, Minn., 1,500 alternating; Astoria, Ore., 100 arc.; Ashville, Tenn., 150 arc, 600 alternating; Grand Rapids, Mich., 200 arc.; Pasadena, Cal., 1,200 alternating; Wabasha, Minn., 300 alternating; Austin, Minn., 520 alternating; Milwaukee, Wis., 50 alternating; Wichita, Kan., 1,300 alternating; Reno, Nev., 600 alternating; Mason, Mich., 30 arc; Joplin, Mo. 50 arc.; Burlington, Kan., 30 arc; Richmond, Mo., 35 arc.

The Trip to Chicago.—Among the many pleasant incidents connected with the visit of the New England delegates to the Chicago Convention of the National Electric Light Association was the presentation to Col. C. M. Ransom of a unique souvenir of the trip. Colonel Ransom had so successfully piloted the party from Boston to Chicago, via Niagara Falls, where a delightful half day was spent, that his friends could not refrain from an expression of their appreciation of his efforts. They therefore summoned the Colonel to meet them after the final adjournment of the Convention, when they presented him with a silver medal bearing on one side a facsimile of the Wagner car "Tamarack" (the special car in which the trip was made), and on the reverse side a suitable inscription in commemoration of the little occasion. The Colonel accepted the token in his usual graceful and hearty manner, after which the whole New England party partook of a banquet.

Local Consolidation at Concord.—The Concord, N. H., Electric Light Company has sold its plant to the Concord Gas Company, and hereafter the combined interests will be operated under the name of the Concord Gas and Electric Light Company. The plant consists of three dynamos and 126 arc lights, and the purchase includes everything owned by the latter company, possession to be given on April 1, 1889. Edgar H. Woodman was unanimously elected treasurer, vice John M. Hill, resigned. The company will be managed by the directors of the Concord Gaslight Company, of which John Kimball is president. William Badger will be superintendent of the gaslight department, and Stevens & Hammond of the electric light department. The electric light plant was installed by Messrs. Stevens & Hammond some 3 years ago, and is one of the most substantial in New England. By supplying light of excellent quality at a reasonable price they have made the venture a success, but as the demand is greater than they can supply they have deemed it to be for the interest of all concerned to have one company, rather than competing companies, furnish the city with its electric lights. An incandescent plant will be installed in connection with the present arc light plant as soon as the necessary arrangements can be made. Choice can then be made between gas, arc, or incandescent lighting.

An Isolated Waterhouse Plant.—In the early part of November, 1888, the Billings & Spencer Company, of Hartford, Conn., fitted up their works with the latest improved systems of the Waterhouse Electric Company, both arc and incandescent. The plant as running now consists of an incandescent dynamo of 130 16 c. p. lights, and an arc dynamo operating 20 lights. These machines are driven by the same engine that runs the entire works, and the result has been so satisfactory that they do not anticipate that it will be necessary for us to put in a special engine to drive the electric plant. The arc lights in particular work with unvarying steadiness and give perfect satisfaction. They have placed orders with the D. Frisbie Company for clutch pulleys for the dynamos, by the use of which they will be enabled to shut down or start up the machines without throwing off the belts or stopping the engine. Their business in Billings' patent commutator bars, drop-forged of pure copper, has steadily increased and they are now making them for all the principal manufacturers of dynamos and motors. They have lately taken up something new in commutator bars for motors, in the way of bronze forgings. This is a new departure in the commutator bar business and as far as they know, the successful forging of bronze has never been accomplished until within the last two or three months. It is unnecessary to expatiate on the superiority of bronze forgings over castings made from the same metal. The bronze forgings have a uniform molecular structure and density throughout that is seldom realized in castings. This metal is called Tobin bronze and is manufactured by the Ansonia Brass & Copper Co. It has a good tensile strength, the breaking strain being 79,000 pounds per square inch. These forgings are not limited to the commutator bar business, but are a very superior article where toughness and non-corrosiveness are required. There is also an increasing demand for iron and steel forgings for parts of dynamos, arc lamps, etc. They continue to have a very gratifying trade in eye bolts, wrenches, etc., used in the manufacture of electrical appliances.

W. L. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 City Trust Building, Philadelphia, Pa., March 2, 1889.

Hightstown, N. J., has asked for bids for electric lights.

Mr. A. J. De Camp, who was elected first vice-president of the National Electric Light Association at the annual convention just closed, has been in receipt of many letters congratulating him on the well deserved honor.

Mr. C. M. Knapp is announced to speak before the Philadelphia Electrical Association this Saturday evening, on "Construction of Batteries." Mr. Knapp's experience in this line is varied and extensive, and his fellow members anticipate a "feast of reason."

Cleverly's Home Coming.—"I am glad to get home and rest," said Mr. H. A. Cleverly, who so ably represented Philadelphia at the late convention. "There were so many things to see in the exhibition and so many friends to greet, that my time was pretty well occupied." Mr. Cleverly, nevertheless, looked as if he had enjoyed himself in the Western metropolis.

Canvas Backs and Electric Light.—The steamboat "Tangier," belonging to the Eastern Shore Steamboat Company and plying between Baltimore and Snow Hill, Md., has just been fitted up with a search light of 5,000 nominal c. p. The current is from a 100-light incandescent dynamo made by C. R. Arnold & Co., of Chester, Pa. Every trip the steamboat makes, the ducks, which abound on the Chesapeake, are attracted by the brilliant glare, fly blindly

against the glass guard, sometimes fatally hurting themselves and in one instance breaking the glass.

A Big Demand for Damages.—The case of William Jones against the Edison Electric Illuminating Company, of West Chester, has been placed on trial in Chester County courts. The case arises from a boiler explosion at the company's station, on Dec. 16, 1887, when five persons were killed and several badly injured. Among those killed was Mr. Jones' thirteen-year-old daughter, Hettie, and he now brings suit for $10,000 damages.

The Self-Storage Electric Company is the title of a new company just formed for placing an improved type of primary battery on the market. These will be used for house lighting and motor work, and in every instance where a strong current is required, so as to dispense with a generator and driving machine. Mr. J. H. Jenkins is the inventor of the battery and general manager of the company, which has headquarters at No. 733 Sansome street.

The Electro-Dynamic Company has just put a storage battery plant in the main offices of the Pennsylvania railroad, on Fourth street. The plant consists of 280 cells of the Electrical Accumulator Company's type, with a capacity of 350 ampère-hours and a potential of two volts per cell. They are arranged in series of 56 cells each, and at present are used as a regulator for the lamp circuit. This is the second accumulator plant placed in this building.

Miles and Miles of Wire.—Mr. H. D. Brown, the electrician of the Pennsylvania Railroad's main offices, favored me last week by showing me the electric light plant in the big buildings on Fourth street. The 1200 lights scattered throughout the offices and corridors are fed by two Edco dynamos, manufactured by the Electro-Dynamic Company, and driven by a 100 h. p. high speed engine, made by the Southwark Foundry and Machine Company. Not the least interesting features of the electrical appliances in the buildings are the systems of call bells, magnetic alarm clocks, annunciators, telephones and telegraphs in the many different offices. Mr. Brown assured me that there were over 300 miles of wires in actual daily service, and doubted if any structure in this country could show such a length of copper. There is some talk of the company increasing its plant, and it is possible that a Corliss engine will be introduced, so that the many elevators can be run by the same engine that drives the armatures of the dynamos.

The Novelty Electric Company, manufacturers of supplies, at Nos. 50, 52 and 54 North Fourth street, this city, have just issued one of the neatest and most complete catalogues of "everything electrical" that it has ever been my pleasure to examine. There are 100 pages of illustrations, descriptions and price lists, and the buyer need only to refer to this book to find anything he may want from an arc light machine to a toy motor. Most of the goods listed are made by the Novelty Company, but they also illustrate many staple articles for which they are selling agents, such as okonite wire, closed and opened circuit batteries of well-known makes, Ball dynamos and lamps, Stubs' & Barber's construction tools, electrical measuring instruments, etc., etc. This company is increasing its capacity to meet the demands for its goods. Mr. Charles E. Trump, the general manager, says that the trade since Jan. 1 has been larger than during any previous corresponding period in the history of the company's existence. In his prospectus, Mr. Trump says: "The Novelty Electric Company is the largest electrical supply house in Philadelphia, and is prepared to furnish at competition rates every kind of electrical work and supplies. In addition to fine goods of our own manufacture, we carry in stock everything of electrical merit from other manufacturers." If energy, business ability and go-aheadativeness count for anything in this daily struggle for existence, there is no doubt but that the Novelty Company will soon be found in front of the front ranks of its particular line.

A Model Plant.—Mr. W. A. Stadelman, of the firm of Chadbourne, Hazelton & Co., has a very complete installation for lighting, power and heating at his private residence at Bala Station, on the line of the Schuylkill Valley Railroad, about five miles from this city. Last week Mr. Stadelman sent invitations to a few of his friends in the electrical field to inspect this plant, and of the number who availed themselves were Mr. E. A. Scott, Mr. Bedell, of the Electro-Dynamic Company; E. V. Cavell, of the *Street Railway Gazette;* T. C. Smith, R. Mucklé, Jr., and John Mucklé, of the Westinghouse Company; C. A. Bragg, of the United States Company; William Hazelton, W. J. Steen, of the Franklin Construction and Banking Company; William Armstrong and Edward Connor, of Armstrong & Conner; J. M. Cardeja and A. P. McDowell. The party left Broad street station for Bala at 8 P. M., and returned about 11:30 P. M., delighted with their trip and profuse in their praises of what one of their number called "a model plant." The dynamo is a 100-light machine, made by the Electro-Dynamic Company, of this city, driven by a 5 h. p. Westinghouse automatic engine. Steam is furnished from a 12 h. p. Shapley boiler. The house and stable are wired for 65 16 c. p. Edison and Sawyer-Man lamps, while 10 similar lamps are placed at the entrances, porches, and outside the buildings. Twenty-three storage batteries of the Electrical Accumulator Company's 23C type are used to furnish current at night, or when it is necessary to repair the engine. The whole is inclosed in a very attractive building, 8 x 24 feet long. Since this plant was first started there has never been any halt in its workings. A small motor drives a couple of dumb waiters in the house and steam is furnished for heating purposes. E. F. C.

WESTERN NOTES

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, March 2, 1889.

New Agency for Grimshaw Wires.—The St. Louis Electrical Company has secured the agency of the Grimshaw white core cables, wires and tapes.

Nashville, Tenn.—The city of Nashville has purchased a 50-light incandescent plant of the Thomson-Houston system to be used in lighting the water-works.

Spokane Falls, W. T.—The Western Department of the Thomson-Houston Company have sold for shipment to this point an arc plant consisting of 50 lights.

Personal.—Mr. C. D. Shain, formerly with the Western Department of the United States Company, has accepted a position as traveling salesman for the Westinghouse Electric Company.

Faribault, Minn.—An alternating plant consisting of 500 incandescent lights has just been sold in this city through the Western Department of the Thomson-Houston Company at Chicago.

Omaha, Neb.—The Omaha Motor Railway Company, of this city, have contracted with the Thomson-Houston Company through its Western Department for an electric road 7¼ miles in length, to operate ten motor cars, each one of which will tow an additional car, making twenty cars in all.

The Lyman Exhaust Head.—Among recent orders to equip electric light plants with his exhaust heads, Mr. W. C. Lyman reports the following: Auditorium plant, Chicago, two No. 14s; Rhode Island Electric Light Company, Providence, R. I. The Van Depoele Company are also using the improved head.

The C. & C. Motor in Kansas City.—The Kansas City agency of the C. & C. electric motor has been assigned to Mr. Floyd Platt, who is well known in that section as the agent for the New York Safety Engine. The C. & C. motor is rapidly coming into use in all portions of the West, and its interests will be ably taken care of by Mr. Platt in his territory.

Large Sale of C. & C. Motors.—Through the Western Department of the C. & C. Electric Motor Company an order has just been placed for 50 ⅙ h. p. motors, which will be used in running cloth-cutting machines. I also learn that the company are winding for the same purchaser a number of dynamos on the ⅙ horse-power motor frame, which will be used in driving the motors.

"Steam Plants for Electric Lighting, etc.," is an excellent manual-catalogue just issued by the Pond Engineering Company, of St. Louis, giving details of the apparatus they handle and useful data for estimates, etc. It is supplemented by a number of fac-simile testimonials as to the high quality of the work done by the company, which has now equipped literally hundreds of plants.

Mrs. W. A. Crowdus, wife of Walter A. Crowdus, died recently after a short illness at their home in Nashville, Tenn. The young husband, who has just started in this life a practical student of our science, has met the severest blow that could be meted out to him. His loss we cannot share or lighten; but future cares will seem the lighter to him by an ever sweet remembrance of the noble and christian deeds of his wife.

New Cut-Outs, Ammeters, Etc.—The Central Electric Company, always alert for new and first-class specialties offered the trade, have just secured the agency for the K. W. double pole cut-out rosette. It is artistic in make-up, the special feature being that it has a double instead of single pole. Besides this they have also secured the sole agency for the Lockwood ammeter and polarity indicator, for which many points of merit are claimed.

Leonard & Izard.—Messrs. Leonard & Izard, electrical engineers and contractors of this city, have secured the contract for the construction of the electric railway which is to be put in at Atlantic City. The system is that of the Sprague Company, and the road will be between three and four miles in length, with curves at each end. The road will be owned by the Pennsylvania Railroad Company and will be used by them for summer travel. It will have the best of equipment throughout.

Kansas City, Mo.—The Vine street motor line, of this city, will be operated henceforth as an electric railway, the contract having just been placed through the Western Department of the Thomson-Houston Company for the necessary apparatus. Six cars will be operated over three miles of track. The Metropolitan Street Railway Company, of this city, will also operate 4¼ miles of track as an electric road. The Thomson-Houston system will be used, and they will start with five cars.

Southern Electrical Supply Company.—A short time ago mention was made in these columns of the formation of the above-named company in St. Louis. I am enabled now to give the personnel of the officers of the company, as follows: J. F. Porter, president; W. H. McKinlock, vice-president; W. C. McKinlock, secretary and treasurer. These gentlemen are well known to the electrical trade, and will have the best wishes of friends for success in their new undertaking. They have fitted up a large store in a substantial manner and carry in stock a full line of everything electrical, making a specialty of Okonite wires, cables and tubing, Candee weather-proof wire, Butler hard rubber specialties, Okonite and Manson tapes, etc.

Electrical Specialties.—The Electrical Supply Company inform me that they have made special arrangements for the handling of a very fine grade of cedar poles, direct from first hands, so that they will hereafter be in shape to quote lowest prices. They have also arranged to have manufactured exclusively for them insulators made of lava of the different sizes, the same as porcelain insulators. The advantage claimed for lava over porcelain is that it does not as readily absorb moisture. The company are also putting on the market a rope made for them, so treated that it is waterproof, being especially designed for outside use. They also inform me that they have accepted the Western agency for the Fowler dynamo speed indicator, which is low in price and is especially designed for dynamo work. I also learn that they have arranged to carry in stock and act as Western agents for the Beattie battery zincs. These zincs, it is claimed, are uniformaly amalgamated throughout their entire mass, and have advantage both in the amount of energy attainable and length of life over ordinary commercial zincs.

Special Electric Machinery.—Dropping in at Forée Bain's this week I found him busy in completing a large number of special electric machines. Among these was a dynamo to be used for electrotyping purposes, manufactured for the American Electrotyping Company, of this city. The dynamo is a 4 volt machine with a capacity of 2,000 ampères. He informs me that he intends making a specialty of machines for this purpose. There was also under construction a 10 horse-power dynamo designed especially for charging storage batteries, which is to be used in the storage battery plant of the Simonds Bros., of Detroit, which lights their factory and store. Mr. Bain also has under construction a small dynamo to be run by a windmill and to be used in charging storage batteries for lighing a private residence in Omaha, Neb. Besides these machines he has also just completed the construction of an automatic cut-out, recently invented by him, which can be placed in an arc light circuit used for charging storage batteries and so arranged that it automatically cuts the battery out of the circuit before the dynamo stops and cuts the battery in again when the dynamo has been started and has attained its proper E. M. F.

Personal.—Mr. Theo. P. Bailey, of the Railway Department of the Thomson-Houston Company, who has recently been confined to his house with severe illness, is much improved and able to be at his desk again.

Messrs. Addison and Searles, formerly of the Western Department of the United States Company, have accepted positions with the Western Department of the Thomson-Houston Company.

It is rumored that Mr. Geo. Cutter, of Chicago, who has been connected with the Thomson-Houston Company for the past six years as an electrical engineer and expert, is to sever his connection with that company, having accepted the Western agency for Pettingell, Andrews & Co., of Boston, and that of the Simplex Electrical Company, also of Boston. If this proves true, both himself and the companies he will represent are to be congratulated, as Mr. Cutter is well known as a young man of large experience in electrical matters, of the highest integrity and character, and in his new enterprise is sure to display his characteristic energy.

Mr. C. C. Warren, the former manager of the Western Department of the United States Electric Lighting Company, has been tendered, and, I learn, has accepted, a position with the Western Department of the Thomson-Houston Company, and it is understood will have charge of the incandescent electric light business. Throughout the West, Mr. Warren is well known as an enterprising and energetic worker in the electric light field. E. L. P.

SOUTHERN NOTES.

BALTIMORE, MD., Feb. 25, 1889.

At Johns Hopkins.—The thirteenth anniversary of the Johns Hopkins University was celebrated on February 22. The exercises were very interesting and the attendance was unusually large. Dr. Adams, Professor of History, delivered an address upon the "Encouragement of Higher Education." President Gilman then enumerated the work being carried on in the several departments, and the results reached, dwelling especially long upon the work of Professor Rowland, in relation to light and electricity. He then showed one of the latest Rowland photographic maps of solar spectrum, and pointed out how, though insignificant in appearance, it represented years of work and perseverance. The public were then invited to inspect the libraries, chemical and biological laboratories; and special invitations were issued to many to attend Professor Rowland's lecture on "Modern Views with Respect to Electric Currents." As such views from an authority so high cannot fail to attract attention and interest, I presume you will probably have something about it in your columns.

At 6 P. M., at the Mount Vernon Hotel, President D. C. Gilman, Profs. Henry A. Rowland and Louis Duncan entertained a party of visiting scientists at dinner. There were no formal addresses. Among those present were Profs. W. D. Marks and Geo. F. Barker, of the University of Pennsylvania; Prof. R. H. Thurston, of Cornell University; Mr. F. J. Sprague, of the Sprague Motor and Electric Company, New York City; Prof. Cleveland Able, of the United States Signal Service, Washington, D. C.; Hon. Gardiner G. Hubbard, of Washington, D. C.; Prof. A. Graham Bell, inventor of the telephone, Washington, D. C.; Commander Sampson, United States Naval Academy; Prof. Terry, of the Naval Academy; Capt. C. E. Dutton, of the United States geological survey; Prof. A. W. Wright, of Yale; Prof. E. W. Blake, of Providence, R. I., and President Gilman, Profs. H. A. Rowland, Simon Newcomb, Ira Remsen, Drs. Duncan, Kimball, Craig and Liebig, of the Johns Hopkins University.

At night a gathering of the students and their friends was held in the physical laboratory. R. B. O.

THE TELEGRAPH.

Western Union Earnings this quarter will, it is reported, be $250,000 more than was expected.

THE TELEPHONE.

The Telephone in Connecticut.—The bill imposing a fine of $500 on any person who shall be convicted of tapping a telegraph or telephone wire for the purpose of obtaining information or listening to the transmission of messages was passed by the State Senate on February 27. It is an outgrowth of the Trowbridge-Ingersoll divorce case in New Haven.

Bell Files his Answer.—In the United States Circuit Court, at Boston, Alexander Graham Bell has filed a plea and answer to the suit brought against him and the American Bell Telephone Company by the United States to annul the patent alleged to have been procured by him by fraud. The plea is a denial of fraud, and the argument used against a further trial is that the matter has already been gone into by the courts and decided. The answers filed by Bell and the company claim that Bell is the original and sole inventor of the patent. The answers will not be used unless the plea is overruled. In the Supreme Court it was decided that the defendants must answer to the suit.

APPLICATIONS OF POWER.

The Daft System of stationary motors and electric roads is admirably brought to public notice in a page of the New York *World* of March 3. There are several illustrations, and the accompanying article is well written.

THE ELECTRIC LIGHT.

New York City.—The Park Commissioners are advertising for bids on the electric light plant for the Metropolitan Museum of Art.

Particulars Wanted.—Judge Van Brunt, of the Supreme Court, has decided that the United States Illuminating Company must furnish the members of the Board of Electrical Control, whom it is suing for $250,000 damages, with a bill of particulars.

PERSONALS.

Mr. P. C. Burns, of St. Louis, Mo., is in the East, and was a recent caller at this office.

Mr. James Ricalton, who has been round the world on a special trip for Mr. Edison, returned home to Maplewood, N. J., a few days ago. His mission took him to the East—India, Ceylon, etc.—and he was gone just a year.

Mr. Charles Barnard has a bright and suggestive article in the March *Century* on "Something that Electricity is Doing," being an account of the rise and development of the electric motor, and of the social changes that its introduction is involving.

Mr. Elmer A. Sperry received, while in active attendance at the Chicago convention, the news of the death of his father at Cortland, N. Y. Immediately after the convention he came East to the funeral and after performing the last sad duties, proceeded to Washington on patent business.

Prof. E. L. Nichols, of Cornell University, will read a paper on Tuesday next, March 12, at 8 P. M., before the American Institute of Electrical Engineers on "The Efficiency of Methods of Artificial Illumination," at the College of the City of New York, Lexington avenue and Twenty-third street. The paper will be illustrated by the lantern. Gentlemen interested, but not members of the Institute, are invited to attend.

MISCELLANEOUS NOTES.

The Paris Exposition.—The United States Commissioner to the Paris Exposition of 1889 is collecting a complete list and set of the catalogues and prospectuses of the electrical and allied industries in this country, for exhibition. It is also forming an album of photographs and drawings representing electric light plants, installations, factories, machines and instruments constructed in America. Good success has already been obtained.

BUSINESS NOTICES.

Ball Engines.—No manufacturers of engines are more alive to the demands of the present time for first-class engines than the Ball Engine Company, Erie, Pa., manufacturers of high-speed automatic cut-off engines. All wearing parts of their engines are scraped to surface plates, and only the very finest material and workmanship is allowed to be used in their construction. The crowning feature of the engine is its perfect regulation and high degree of economy. We advise intending purchasers of engines, whether for electric lighting or electric power, to write to the Ball Engine Company for catalogue and prices.

The New York Belting and Packing Company, New York, have recently appointed the Atlanta Rubber Company, Atlanta, Ga., their Southeastern representative. The latter firm are well-known throughout that section of the country, and have acquired an enviable reputation for square dealing, careful and prompt attention to orders and business courtesy. They will carry a very large stock and complete assortment of the New York Belting and Packing Company's vulcanized rubber goods.

Patterson, Jordan & Gottfried, 146-150 Centre street, carry a complete stock of brass and iron machine and wood screws, cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rod, sheet German silver, sheet brass, machinery, tools, hardware, etc. Electric motor supplies.

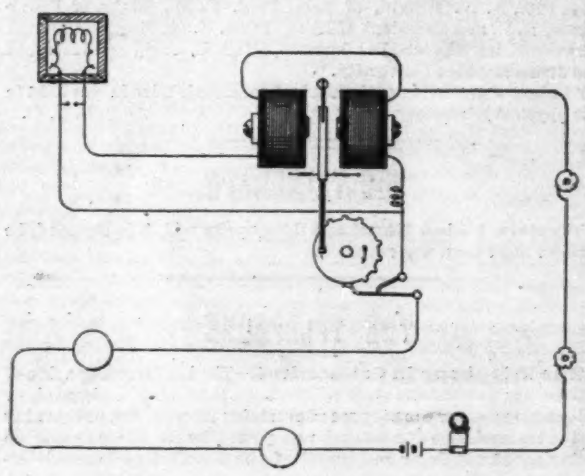
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED FEBRUARY 26, 1889.

398,402. Current Collecting Device for Electric Railways; R. M. Hunter, Philadelphia, Pa. Application filed June 7, 1888. A suspended conductor is properly insulated from the ground and arranged parallel with the railway, and the car is provided with a suitable contact device—such as a grooved wheel—which presses upon the under side of the conductor and thus makes a traveling or running contact therewith, the relation between the conductor and collector being such that either or both may be permitted to move vertically to compensate for any variations in the parallelism of the line conductor.

398,409. Electrode for Secondary Batteries; E. M. Lang, Falmouth, Maine. Application filed Oct. 29, 1889. An electrode for accumulators or electric storage batteries, consisting of fine threads of lead compressed into the desired form.

398,420. Electric Burglar Alarm; L. A. McCarthy, Brooklyn, N. Y. Application filed April 18, 1888. The main circuit is divided into two branches, the current normally flowing through both of them and always flowing through one of them; a magnetic



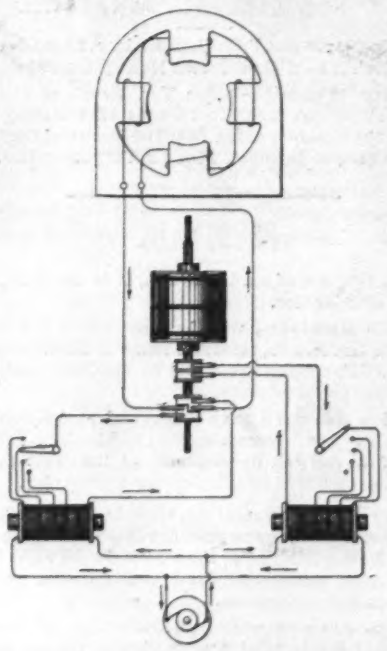
398,420. ELECTRIC BURGLAR ALARM.

coil and an artificial resistance is located in each branch, making the total resistance in each branch equal. An armature is normally balanced between the coils and it locks a definite signaling apparatus. An excess of attraction of either of the coils will unlock the signaling apparatus, and as soon as the energization of the deflecting magnet becomes normal the signaling apparatus will be locked. See illustration.

398,441. Telegraph Cable; W. R. Patterson, Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed May 24, 1886. The combination with a core of insulated conductors, of an impervious serving wound thereon, the outside lead pipe, and the filling of coal tar or its equivalent, between the lead pipe and serving.

398,442. Telegraph Cable; Wm. R. Patterson, Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed July 18, 1887. The invention consists in loosely twisting the conductors together and dispensing with a serving, so that the core, when surrounded by the lead pipe, will substantially fill the same, and the wires being only twisted loosely together, the insulating filling of paraffine or other substance will become solid as it cools and fill, as it were in mass, the spaces between the different wires. See illustration.

(1) 398,457; (2) 398,458. Alternate Current Electric Motors; O. B. Shallenberger, Rochester, Assignor to the Westinghouse Electric Company, of Pittsburg, Pa. I. It is designed to



398,457. ALTERNATE CURRENT ELECTRIC MOTOR.

apply independent electromotive forces to the armature and the field-magnet coils, and to control the potentials, as may be required, during the increasing speed of the armature. Electric currents are supplied to the armature through a converter, reducing the potential of the current upon the main line in case it is too great to be handled conveniently. Such a converter serves, also, to vary the potential applied to the armature in a manner similar to that which would be accomplished by the use of a rheostat. A second converter supplies the current to the field magnet coils, and this is so proportioned that the lowest potential it can yield is suitable for the operation of the motor after it has attained a proper speed and the flow of current has become continuous in direction by reason of a commutating device carried upon the shaft of the armature. When the motor is started the alternations take place in the direction of the current delivered to both field-magnet and the armature, and the current will continue to alternate through both until the armature has attained a proper speed. When this speed is attained, however, the commutating device, through which the currents are supplied thereto, will serve to render continuous in direction the current delivered to the field magnet, while that delivered to the armature remains alternating. (See illustration.) (2) In carrying out the invention the field magnet is caused to be excited by currents transmitted through a suitable commutator, and may conveniently be divided into two different circuits, which respectively include the coils applied to the alternate poles of the field magnet. The magnetization of the field magnet is carried to a very high point of saturation at the commencement and gradually decreased as the motor gradually increases its speed. To accomplish this a converter is employed for delivering secondary or induced currents to the field magnet circuit, and the effect of this converter may be varied, so as to apply a higher or lower electromotive force to the field, as may be required.

398,489. Support for Electric Railway Wires; Thomas H. Brady, New Britain, Conn. Application filed Sept. 19, 1888. The cross-arm is built telescopically, so that it may be extended or shortened at pleasure.

398,498. Conductors for Electric Railways; Olof Dahl, Brooklyn, New York. Application filed Nov. 22, 1888. The invention consists generally of a continuous metallic conductor thoroughly insulated and imbedded in the conduit or road-bed in combination with a sectional conductor which is exposed within the conduit. The sections of the latter conductor are placed in electrical connection with the main or continuous conductor by the weight of the vehicle or current collector connected thereto. The particular point of novelty lies in the means employed for accomplishing this connection between the main and sectional conductors. Claim 1 is as follows: In an electric railway system a main continuous insulated conductor provided at intervals with posts electrically and rigidly connected thereto, the heads of the posts being inclosed by air and water-tight chambers having flexible walls, all in combination with a sectional conductor, the sections of which are movable, and rigidly and electrically connected with the walls of said chamber, whereby a weight upon the sectional conductor will establish electrical connection between the main and sectional conductor. See illustration.

398,507. Mechanical Telephone; A. W. Hall, New York, N. Y. Application filed May 8, 1888. The line wire is connected with one end of a bell crank lever while the button of the diaphragm is connected with the other arm through a link. Adjustable points of connection are provided upon the bell crank for the purpose of altering the tension of the line.

398,510. Electric Switch; W. S. Hill, Boston, Mass. Application filed May 17, 1888. The principle of the snap-switch is utilized in a novel manner.

(1) 398,560; (2) 398,561. Electric Switches; F. A. Weller and A. F. Rietzel, Lynn, Mass. Applications filed Dec. 12 and 26, 1888, respectively. This is a form of snap-switch.

398,566. Electric Cut-Out; W. H. S. Wright, Kansas City, Mo. Application filed Dec. 20, 1888. An electric cut-out comprising two wires joined by a fusible connecting rod and an inclosing insulated transversely divided case, whereby when the fusible rod melts, the wires are prevented from forming a ground connection.

398,577. Electric Brake for Railway Trains; A. H. Bowman, of Packerton, Pa., and W. P. Widdifield, of Uxbridge, Ontario, Canada, Assignors to said Widdifield, A. T. Button, of Uxbridge, and Samuel Street Fuller, of Stratford, Canada. Ap-

398,442. TELEGRAPH CABLE.

plication filed Oct. 29, 1888. Instead of applying the electricity to lift a large friction pulley against the car axle, it is caused to place a smaller friction pulley against the axle, while the force communicated to the latter pulley is transmitted by suitable mechanism to the large pulley. This said force throws the large pulley against the car axle, and, being rotated, causes the brakes to press against the car wheels.

398,613. Electrical Railway Signal; H. Hayden, Jr., and W. F. Z. Desant, of New York, N. Y., Assignors of one-third to A. R. Gooding, of same place. In a system of block signals for railways, a main battery, located at one end of a block section in a circuit including one coil of a switching magnet at the home station, and one coil of an additional switching magnet at a distant station, with a local battery also located at the home station, having circuit connections, and the armature lever of the switching magnet and a local circuit extending into the cab of the engine, including a magnet, the armature of which controls an alarm.

398,614. Quadruplex Telegraphy; Clarence L. Healy, Brooklyn, New York. Application filed Jan. 16, 1888. The invention consists in the means employed for obtaining varying electromotive force from one source of electrical energy, and especially when that source is a dynamo-electric machine, without disturbing the balance of the line; also in the means employed for utilizing this principle in connection with two dynamos or other sources of electrical energy for giving at the same time reversals of the polarity of the current, and in the instruments and connections employed for controlling the transmission of the currents. See illustration.

398,661. Insulating Support for Electrical Conductors; S. H. Short, Columbus, Ohio. Application filed Nov. 6, 1888. The invention relates to the supporting and insulation of electrical conductors, more particularly such as are used for electric railways.

(1) 398,662. Electric Railway; (2) 398,663. Switch Mechanism for Electric Railway; S. H. Short, Columbus, Ohio. Applications filed Nov. 12 and 13, 1888, respectively. (1) The invention consists, broadly, in connection with a main conductor and generator, of a guard wire, including a source of electrical energy, forming a normally open circuit and a controlling resistance connection between the guard wire and the generator, whereby the pressure on the main conductor is automatically controlled. (2) The particular improvements consist in combining with the double line sectional conductor a switch arranged to open and close alternately the sections of the double line, and a trolley adapted to provide a short circuit between the lines at the break and around the switch during the shifting of the said switch to close one and open the other, whereby all sparking is prevented.

398,668. Regulator for Dynamo-Electric Machines; E. A. Sperry, Chicago, Ill., Assignor to the Sperry Electric Company, of same place. Application filed Oct. 22, 1888. A magnetic mass is placed within attractive distance of the field magnets, and the motion which this mass partakes of under the magnetic influence is transmitted to the brushes and changes their position on the commutator, so as to maintain a constant current.

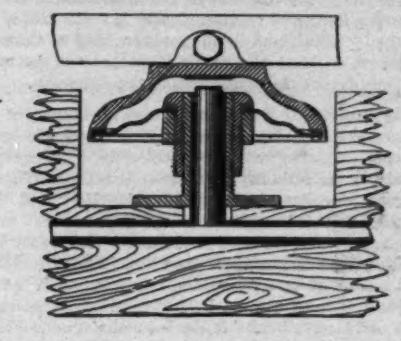
398,713. Stock Indicator; John A. Enos, Boston, Mass., Assignor by direct and mesne assignments, to Edwin Shapleigh, of same place, and H. W. Morton, of Kemptville, Nova Scotia. Application filed March 2, 1888. The invention resides, essentially, in a dial having arranged in front of it a series of hands mounted on centre sleeves, a gear wheel mounted on each sleeve, and a second gear meshing with the gear on the sleeve, operated by a worm wheel and lever receiving motion from a lever caused to vibrate by an electric current.

398,737. Mercury Holder for Battery Zincs; W. P Kookogey, Brooklyn, N. Y., Assignor to the Kookogey Electric Co. Application filed Aug. 13, 1888. A cup partly or wholly of elastic material to hold a small quantity of mercury, and attached to the zinc at or below the surface of the battery liquid.

398,731. Electrical Bathing Machine; Jack W. James, Cuba, Tenn. Application filed June 14, 1888. Claim: In a bathing machine, the combination of a vertically adjustable frame, a rotary brush journaled in said frame and provided with electrodes, an electric battery supported by said frame, and conductors connecting said battery and electrodes.

398,744. Magnetic Regulator; S. E. Nutting, Chicago, Ill., Assignor to the Nutting Electric Manufacturing Company of same place. Application filed Dec. 3, 1887. The essential idea of the invention consists in the employment of a governor or regulator, which is so mounted, hung, placed or arranged in reference to the pole pieces, as to be drawn, moved or swung toward them by magnetic attraction against constantly increasing resistence, whether effected by links, springs, weights or other means, and which, as it approaches the pole pieces, will diminish their magnetic attraction and their action on the armature, and as a consequence the strength of the current, and which will be retracted by rotation, swinging or otherwise, as the attractive power of the magnetized pole pieces is diminished, so that a constant adjustment or regulation of the current in the circuit may be automatically effected and maintained.

398,769. Electric Circuit Coupler; S. C. C. Currie, Philadelphia, Pa., Assignor to the United Electric Improvement Com-



398,498. CONDUCTOR FOR ELECTRIC RAILWAYS.

pany, of Gloucester City, N. J. Application filed Sept. 29, 1888. The coupler consists of two dissimilar halves which it is impossible to connect mechanically without establishing a proper electrical connection.

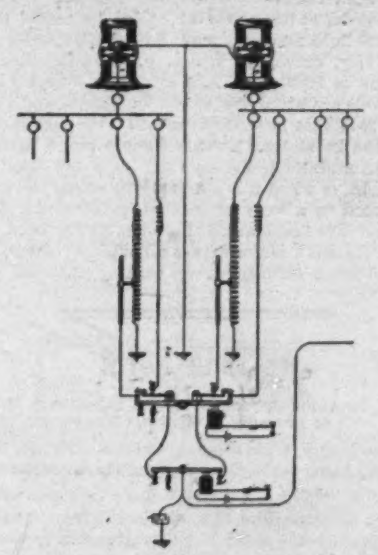
398,774. Incandescent Electric Lamp; Thomas A. Edison, Menlo Park, N. J. Application filed May 14, 1883. Claim: In an incandescent electric lamp, the combination, with the incandescing conductor, of solid insulating material interposed between its terminals and adapted to prevent the formation of an arc between said terminals.

398,794. System of Synchronizing Electric Motors; F. J. Patten, New York, N. Y., Assignor to J. M. Seymour, of same place. Application filed Aug. 1, 1888. A system for producing the synchronous movement of electric motors at distant points, comprising a main line circuit connecting said points, electric motors at said points having their armatures and field coils connected in separate independent circuits, one to a source of direct and the other to a source of alternating current, the supply of current in said alternating circuit being controlled by said main line circuit and by polarized relays or vibrators included in said line circuit.

398,805. Gas Extinguisher; A. Steinhilber, New York, N. Y. Application filed July 27, 1888. A weight is maintained in contact with the circuit terminals by the draught set up by the flame. When the flame is extinguished the weight breaks the circuit and allows a spring to close the gas valve.

PATENTS EXPIRED MARCH 5, 1889.

(1) 124,199; (2) 124,200. Insulators; Moses G. Farmer, Salem, Mass. Patented March 5, 1872. (1) An insulator made of



398,614. QUADRUPLEX TELEGRAPHY.

vulcanite. (2) An insulator made of earthenware molded, threaded and saturated with an insulating compound.

124,216. Magneto Electric Batteries for Firing Fuses Etc.; B. G. Noble, Brooklyn, N. Y. Patented March 5, 187 Iron cored helices are fixed to the poles of a magnet, with a slidin keeper.

124,264. Lightning Rod; F. O. Goodwin, Philadelphia, Pa., Assignor of one-half to Frank Goodwin, of same place. Patented March 5, 1872. The sections of the rod are secured together by projections and indentations.

24,317. Electric Torches for Lighting Gas, Etc.; W. W. Batchelder, New York, N. Y. Patented March 5, 1872. A portable electric torch, in which the generating surfaces are separated and connected by the axial movement of one upon its stem toward the other.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Potter Building, N. Y.

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